Aviation Week and Space Technology

January 2, 1961

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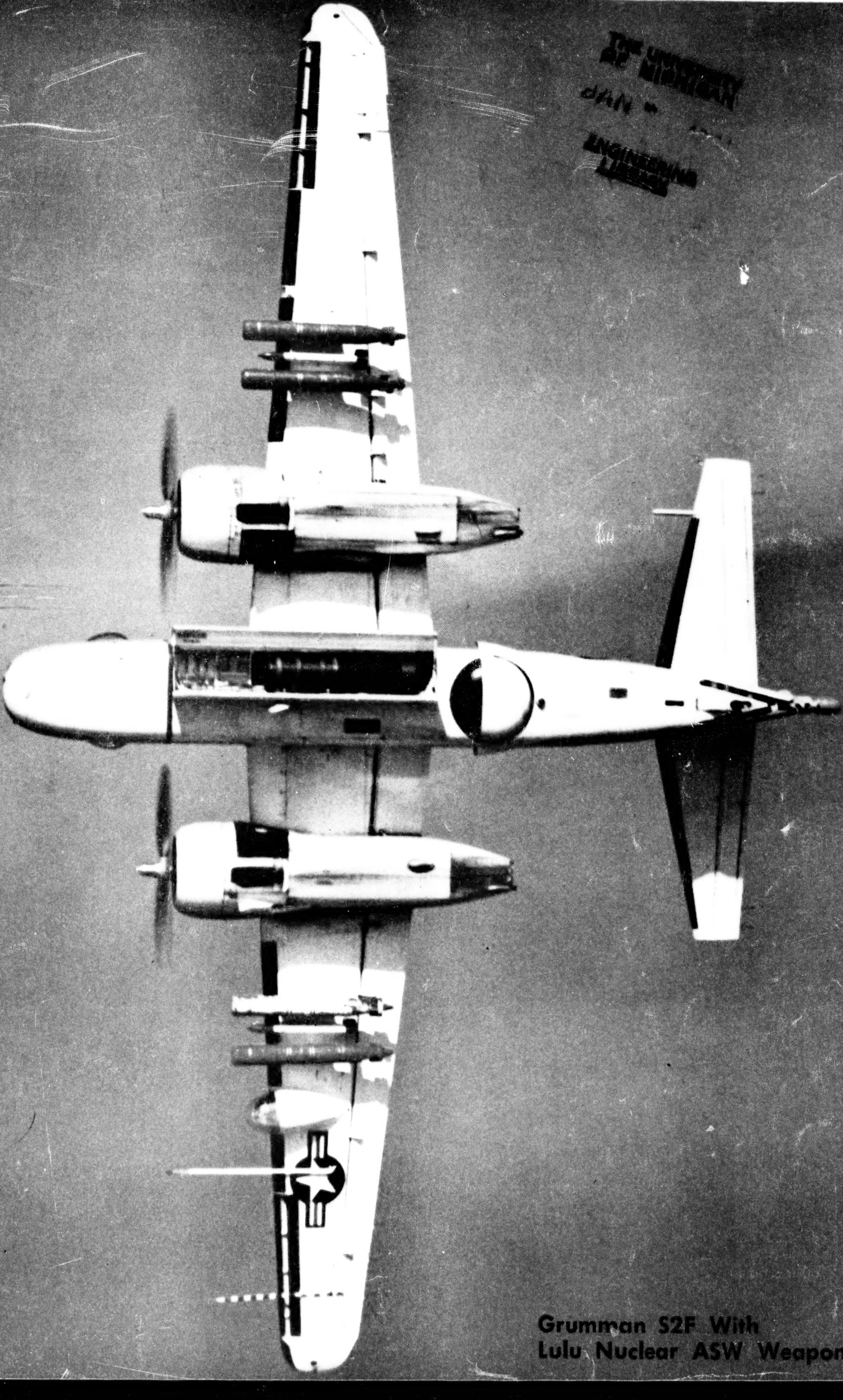
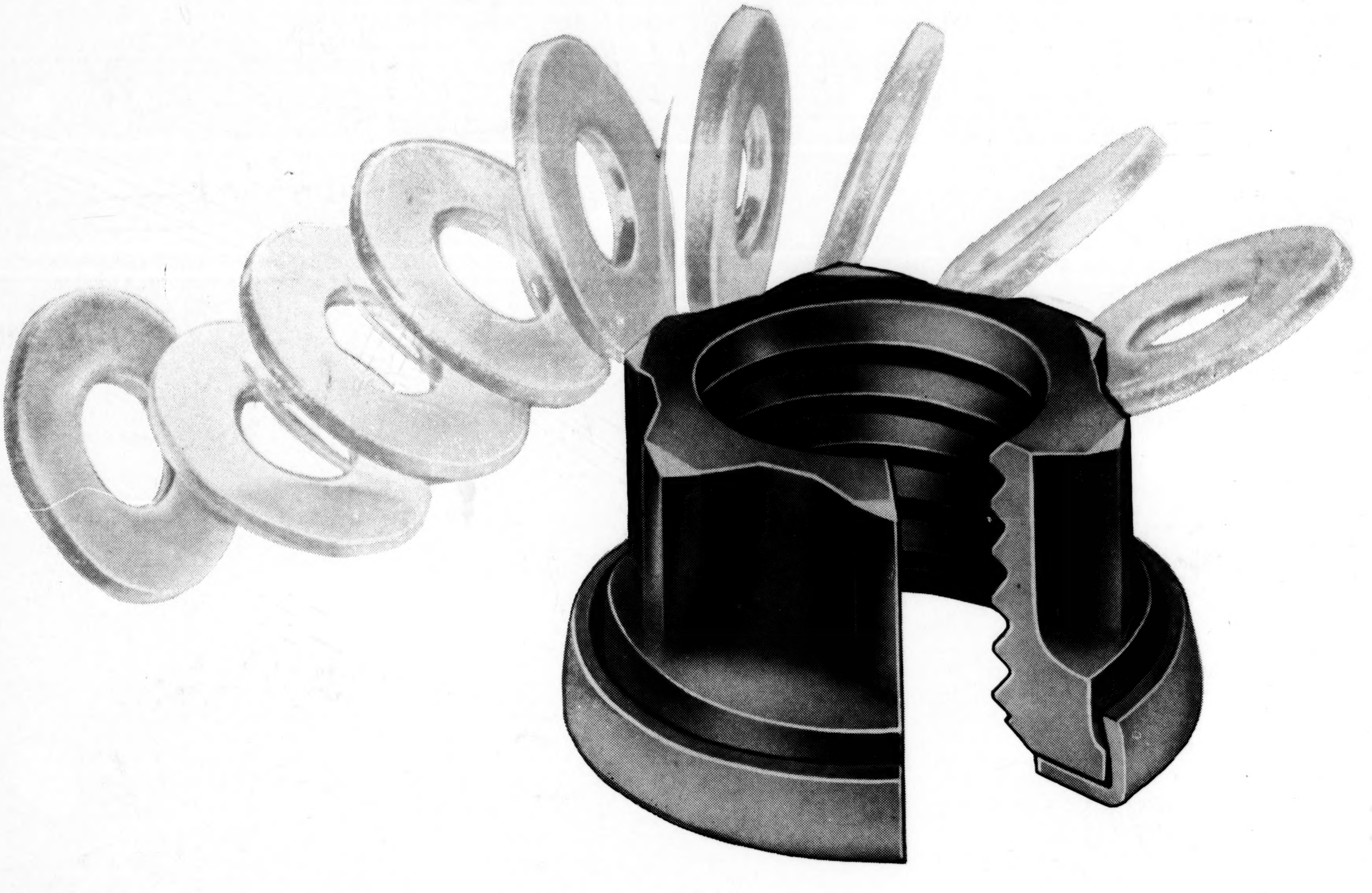


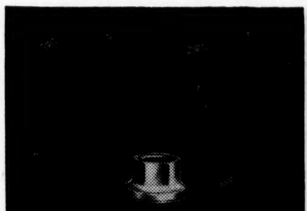
Grumman S2F With Lulu Nuclear ASW Weapon



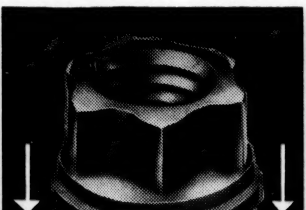
Kaylock® 'captive washer' nut gains wide acceptance!

Since its introduction early in 1960, this new Kaylock® lightweight, all-metal self-locking nut with integral free-spinning metal washer has been specified by leading aerospace manufacturers for an increasing number of applications. Separate washers that used to drop off, roll away, and slide into hard-to-get-at places have been eliminated. The danger of short circuits, due to these forgotten washers, also has been eliminated by the new Kaylock HW14 nut-washer combination.

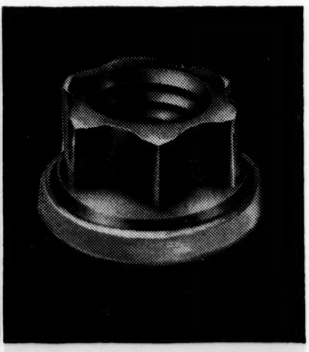
Saves Assembly Time. Kaylock HW14's cut extra motion required to put washer on bolt. Washer can't drop off during application or removal. Cuts time lost looking for wayward washers..*to zero! Safer, too!* Kaylock HW14 "captive washer" nuts employ the same, sure elliptical locking principle to prevent vibration hazards. The Kaylock HW14 is a development of Kaynar Mfg. Co., Inc., world's oldest and largest manufacturer of lightweight, all-metal self-locking nuts. For complete details, call your nearest Kaylock representative.



The Kaylock HW14 is available in size -02 (shown above) and in other sizes to -3.



View of Kaylock HW14-3 and washer prior to assembly.



Assembled HW14-3. Integral, free-spinning washer can't drop off. Only one part to handle instead of two.

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AVIATION CALENDAR

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 15-18—13th Annual Convention, Helicopter Assn. of America, Cherry Hill Inn, Haddonfield, N. J.

Jan. 16-18—Seventh Annual National Meeting, American Astronautical Society, Dallas, Tex.

Jan. 17-19—Winter Instrument-Automation Conference & Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Mo.

Jan. 23-24—Annual Meeting, Assn. of Local Transport Airlines, National Aviation Club, Washington, D. C.

Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 24.

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.

Feb. 14-16—Second Annual Symposium on Non-destructive Testing of Aircraft and Missile Components (unclassified), Society for Non-destructive Testing and Southwest Research Institute, Gunter Hotel, San Antonio, Tex.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel, Philadelphia.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of

(*Continued on page 6*)

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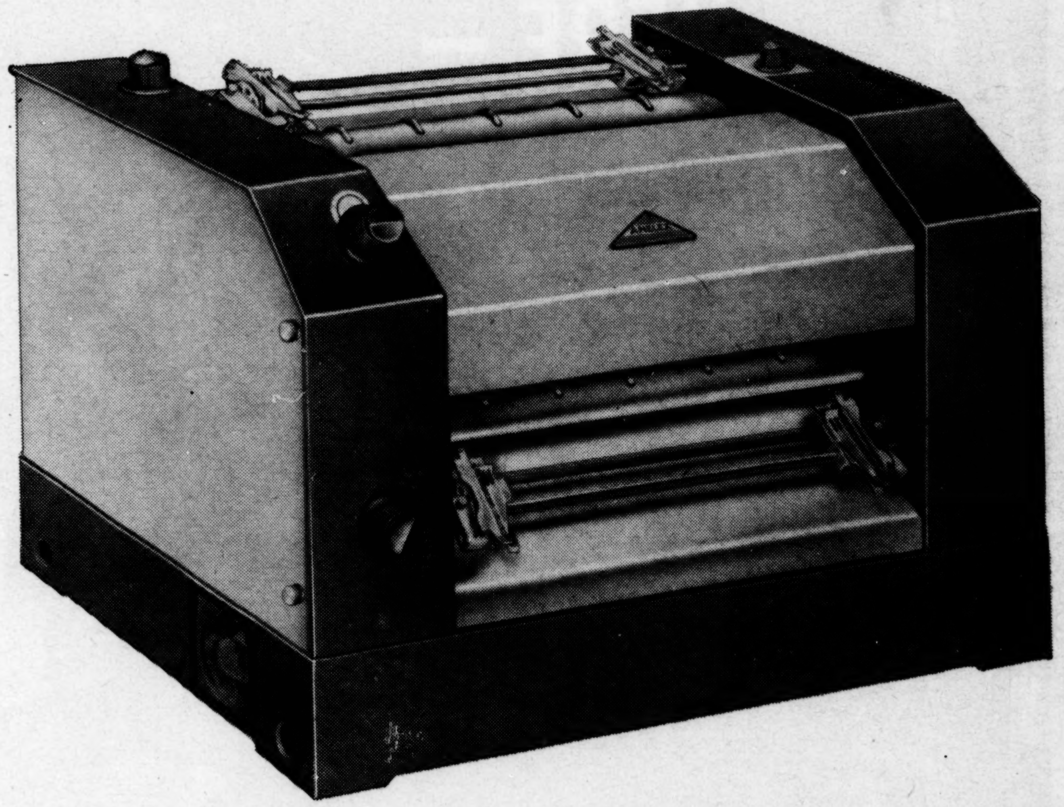

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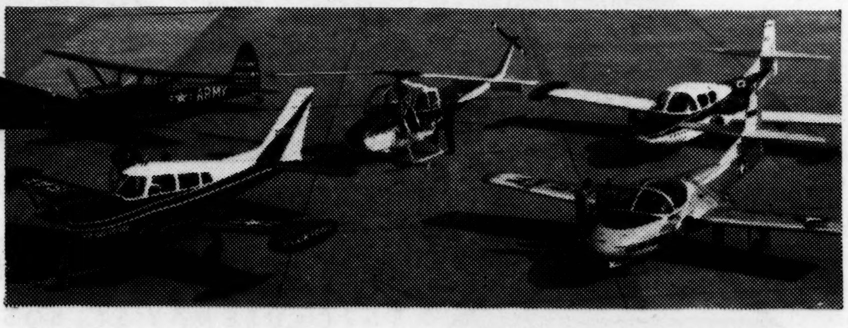

AVIATION CALENDAR

(*Continued from page 5*)

Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio. For information: V. W. Sikora, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aeronautical Electronics Conference. IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

January 2, 1961

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NASA, Defense Seek More Space Funds.......... 16
▶Both agencies ask 50% increase in next budget; Johnson says military program to be strengthened.

FAA Plans to Require DME on Transports........ 26
▶Mandatory rule will be proposed soon for airlines; first installation expected to be on jet aircraft.

Computer Responds to Voice Command.......... 67
▶Air Force tests show possibility of voice communications with digital computers using word recognition technique.

SPACE TECHNOLOGY

Anti-Radiation Shielding Reduction... 40
Project Mercury Costs.............. 17
Recovered Mercury Capsule Damage.. 20
Dust Belt Proton Intensity Control... 24
Space Mice Offspring Unmarked..... 24
Navy Space Program Budget Increase. 41
British Scout Satellite in Development 42

MISSILE ENGINEERING

Vulcan-Skybolt Funding 16
Army Cancels Republic SD-4 Drone... 18
New Minuteman Delay 19
Minuteman Mobile Support Model... 47

AERONAUTICAL ENGINEERING

T63 Passes First Trial Run......... 19
Supersonic Nuclear Flight 50
First Turbofan DC-8 Flies........... 60

AVIONICS

Computer Responds to Voice........ 67
Solar Communications Prototype.... 71
Terrain Radar Simulator Utilizes TV.. 74
Electronic Components Market...... 76
Filter Center 77

AIR TRANSPORT

FAA to Require DME on Transports.. 26
Trunkline Profits Hit 11-Year Low... 27
Landis on U. S. Transport Policy..... 28
Air Maroc Jet Service on One Plane.. 30
Jets Help Lufthansa Register Gains... 32
Paperwork Delays TWA 880......... 33
Shortlines 34
Airline Observer 34
Airline Income & Expenses—October. 37

MANAGEMENT

NASA, Defense Seek More Space Funds 16
Glennan Resigns as NASA Head..... 17
Swiss Seek Funds for Mirage III..... 17
Broader Planning for Defense....... 18
Japanese Rearmament Plans......... 22
AAS/ARS Merger Stalled........... 24
Germans Plan Combat Modernization. 63
Who's Where 13
Industry Observer 13
Washington Roundup 15
News Digest 25

FINANCIAL

Irvine Urges Faster Economic Growth. 78
New Offerings 83
Financial Briefs 84
Stock Transactions 85

Calendar 5
Letters 94

EDITORIAL

Thin Edge of the Wedge............ 11

COVER: Grumman S2F-3 Navy anti-submarine carrier aircraft is banked 90 deg. to show shapes representing a full ASW ordnance load. Open bomb bay reveals a dummy Lulu nuclear depth charge, developed by General Mills. Three ordnance stations on each wing contain shapes representing two General Electric Mk. 44 acoustic homing torpedos flanking a 5-in. aircraft rocket. Conventional depth charges may be carried in the bomb bay or on wing stations.

PICTURE CREDITS

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EDITORIAL

Thin Edge of the Wedge

The brazen use of a Russian-marked Ilyushin 14 transport to drop arms and supplies to the Laotian rebels in Indo-China (see picture on page 23) should serve to emphasize again the manner in which the Soviet Union is using both its growing fleet of gas turbine-powered transports and its surplus of piston-powered equipment as the thin edge of what could develop into a powerful wedge for Soviet imperialism.

The startling growth of Soviet strength in air transport has been evident to even the most casual observers of the Aeroflot scene during the past three years. But there has been a tendency, particularly by U.S. airline experts used to the technical refinements demanded by sharp commercial competition, to underrate the value of this Soviet transport fleet in the international scene. The fact that most of this Soviet equipment, both piston and gas turbine-powered, would have difficulty in competing in the international airline market on purely economic terms has tended to divert these experts from the value of this equipment when shrewdly dispensed as an instrument for expanding Soviet influence in the underdeveloped or politically fermenting countries of the world.

Economic Weapon

The growing Soviet transport fleet is providing the USSR with a number of assets.

- **First,** it is making a tremendous contribution to the over-all economic development of the Soviet Union by providing an element of transport and communication never before possible in the vast reaches of the 19 Soviet states.
- **Second,** it is providing Soviet military power with a mobility and flexibility it has never before enjoyed. The Western world has yet to feel the impact of this vital new factor in the Soviet military equation, but it is already there and must be reckoned with. The air drops in Laos and the swift penetration of the Congo by Ilyushin-borne Russians are significant straws in this wind.
- **Third,** it is providing the thin edge of the wedge for eventual large scale economic penetration of key areas, paving the way for their eventual absorption into the Soviet colonial empire.

Although only a few years ago it was the fashion among U.S. transport "experts" to scoff at the idea that Soviet aviation equipment would ever be any threat in the international market, the initial steps in this penetration are now on the record for all to read. Soviet transport equipment has now penetrated beyond the satellite belt to Africa, India, and the Middle East. The pure economics of these exports is secondary to these customers who have an urgent problem that only air transport can solve, and of course, the political profit from these deals is carefully computed by the Soviets in shaving their prices for this equipment or in arranging suitable barter deals.

A good case history on the impact of this Soviet export drive was provided in the Dec. 12 issue of Aviation Week (p. 38) reporting on the growth of Ghana Airways. In areas where the Soviet flavor is too distasteful for direct negotiations, the Czechs are active in offering Soviet transports and technical support to train operating and maintenance personnel. India, long dependent on British and U.S. aviation equipment, has become an unexpected repository for Soviet helicopters and turboprop transports.

Darkhorse in An-10

While the Il-18 turboprop transport probably has more appeal to new entries into the airline field because of its resemblance to Western-type transports, we have long suspected that the An-10 and its later developments would eventually prove more attractive to these underdeveloped countries because of its ability to use grass and dirt fields, eliminating the requirement for expensive concrete runways. Technical development difficulties have retarded the introduction of this series even in Soviet civil and military transport fleets, but if its "bugs" are eliminated we may see other countries following the Indian example in buying advanced versions of this airplane.

The air transport area is a particularly attractive one for political penetration because it provides an excuse to deposit Soviet technicians in the countries concerned and also provides an opportunity to bring local nationals to the Soviet Union for technical training and exposure to its propaganda.

The U.S. has long operated a technical assistance program in aviation for other countries, and it has been successful in areas ranging from Afghanistan, Ethiopia, Pakistan and the Philippines to South America. However, in view of the new problems arising from Soviet activities in this field and because new areas of the world are developing an urgent need for modern air transport, it might be wise to re-evaluate this program with the idea of revising and expanding it to better fit these changing requirements.

This is an area in which the manufacturing and operational skills of the U.S. aircraft and air transport industry can make a tremendous contribution to the underdeveloped areas of the world. It will take some more imaginative thinking than has been displayed thus far to develop a more effective program in this area and meet the growing Soviet challenge.

—Robert Hotz

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WHO'S WHERE

Honors and Elections

Dr. H. Guyford Stever, professor of aeronautics and astronautics at Massachusetts Institute of Technology, has been elected president of the Institute of the Aerospace Sciences for 1961.

In the Front Office

Dr. Hector R. Skifter, a director, American Research and Development Corp., Boston, Mass. Dr. Skifter is president of Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc.

Dr. Eric A. Walker, a director, Melpar, Inc., Falls Church, Va. Dr. Walker is president of Pennsylvania State University. Also: **Robert E. Miller,** vice president-advanced development.

Robert E. Hilliard, a director, McCormick Selph Associates, Inc., Hollister, Calif. Mr. Hilliard is the company's secretary-treasurer.

Dr. Thomas H. Johnson, director, Technical Operations, Inc., Burlington, Mass. Dr. Johnson is a vice president and general manager of Raytheon Co.'s Research Division.

John B. Tuthill, vice president-finance, and **W. W. Roodhouse,** vice president-administration, Collins Radio Co., Cedar Rapids, Iowa.

Elwood F. Knapp, vice president-manufacturing and a director, The Firewel Co., Inc., Buffalo, N. Y.

Frederick Davis, vice president-planning and administration, Air Transport Assn., Washington, D. C., and **John Hoving,** vice president-executive action.

Stuart L. Bailey, vice president, Atlantic Research Corp., Alexandria, Va. Mr. Bailey continues as president of the recently established Jansky & Bailey Division of Atlantic Research.

H. J. Downes, vice president and division general manager, International Division of Lear, Inc., Santa Monica, Calif.

Noel E. Porter, vice president-operations, Hewlett-Packard Co., Palo Alto, Calif. **Ralph E. Lee** succeeds Mr. Porter as vice president-manufacturing.

John S. Gillespie, executive vice president, Airwork Corp., Millville, N. J., and **Jerome Church,** vice president-sales.

Walter H. Chudleigh, Jr., a vice president, Atronic Products, Inc., Bala-Cynwyd, Pa., a subsidiary of General Atronics Corp.

Edward B. Cochran, vice president-finance, Acoustica Associates, Inc., Beverly Hills, Calif.

Alton W. Beck, vice president-Western operations, Robertshaw-Fulton Controls Co., Anaheim, Calif. **Arthur G. Baitz** succeeds Mr. Beck as director of marketing at the company's Richmond, Va., headquarters.

Michael J. Joncich, vice president, Datex Corp., Monrovia, Calif., a subsidiary of Giannini Controls Corp.

William Falstrom, president, Temcec, Inc., Van Nuys, Calif., the newly organized subsidiary of Cubic Corp.

Bernard Reich, president, Molecular Electronics, Inc., New Rochelle, N. Y.

(*Continued on page 88*)

INDUSTRY OBSERVER

▶ Boeing, Convair and Martin will conduct definitive studies for establishing and maintaining a permanent lunar base under contracts awarded by Air Force Ballistic Missile Division. Funded study work was assigned after an industry competition under SR-17532 (AW Oct. 10, p. 23).

▶ Martin is proposing a three-stage version of Pershing to National Aeronautics and Space Administration as a launch vehicle. Company maintains this advanced version of the two-stage missile would be competitive in payload and cost with the Chance Vought Scout.

▶ Boeing is considering use of the Douglas C-133 for initial air drop test on Dyna-Soar to check the vehicle's glide characteristics. Boeing B-52 is scheduled to participate in the glide test program later as mother aircraft.

▶ Army-Martin Pershing will begin tests with its Group III tactical type nose cone when current Group II nose cone tests are completed in mid-April. Developed and built by Martin-Baltimore for the Orlando Division, the ablative nose cone uses several layers of filament-wound reinforced plastic. Group III cone is similar to the Group II but doesn't have the Group II model's telemetry section.

▶ Ozarc high-altitude probe will be air-launched over the Pacific Missile Range to make synoptic meteorological measurements. Program is conducted by Air Force Cambridge Research Center.

▶ Pratt & Whitney 17,500-lb.-thrust liquid hydrogen engine for the Saturn S-4 stage will be designated LR-119. Engine is an uprated version of the 5,000-lb.-thrust engine developed for the Centaur upper stage, which also will serve as the Saturn S-5 stage.

▶ Initial deployment of Minuteman ICBMs will involve 165 missiles—85 in railroad car units and the rest in silos. Closed circuit television cameras will be used in the control system to monitor the missiles in their cars and silos.

▶ Boeing 727 turbofan transport will be the first U. S.-built transport aircraft to incorporate an all-hydraulic irreversible control system similar to that used on Century series fighters. Advantages are reduced weight and complexity, and capability of providing control system feel through the use of variable bungee systems. Disadvantage is that reliability would have to be proven by Federal Aviation Agency as in the case of the Sud Aviation Caravelle, now flying with all-hydraulic irreversible controls.

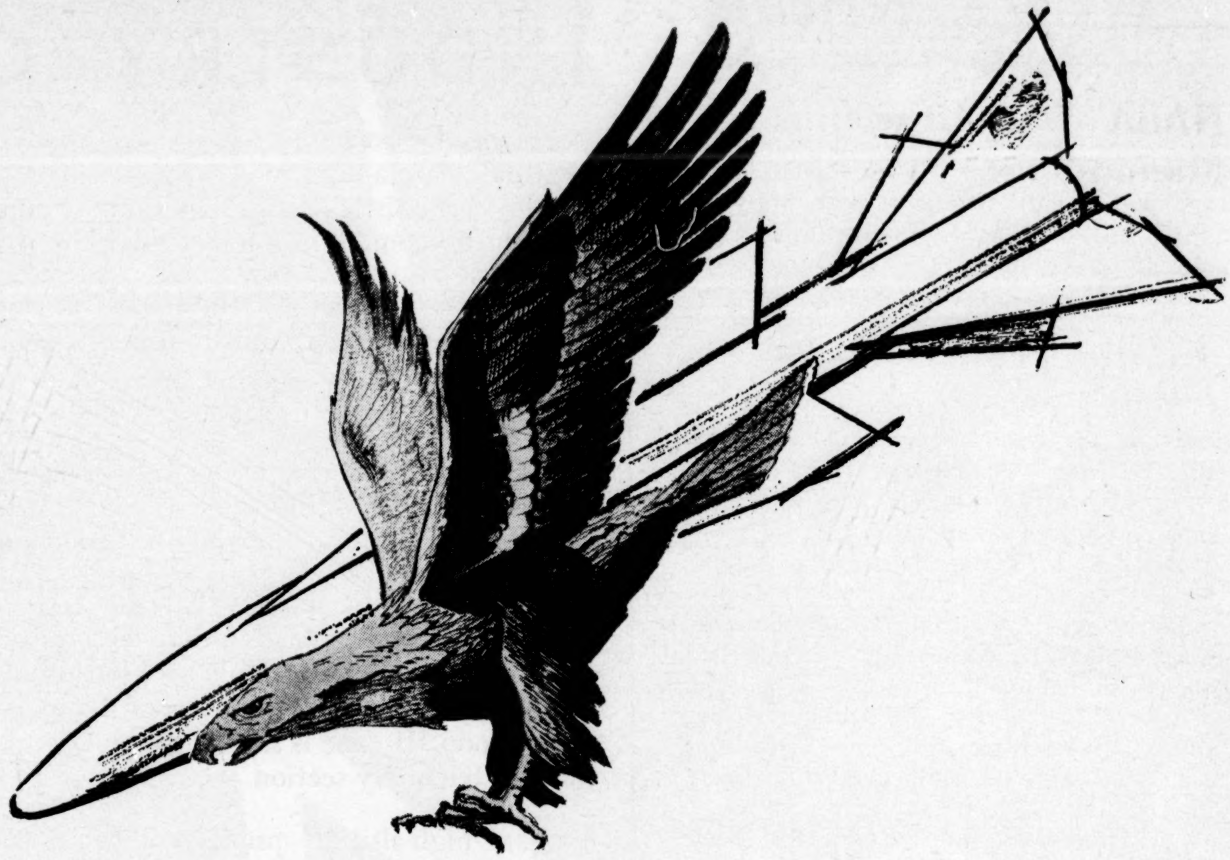
▶ Nord Aviation has begun quantity production of the Max Holste turboprop Super Broussard, and first production aircraft flight is scheduled for mid-1961. Nord plans to produce 17 of the aircraft next year, and the rate is expected to reach a peak of four a month by January, 1963.

▶ Republic Aviation will build a facility to simulate effects of nuclear explosions in space at Air Force Special Weapons Center for Operation Cantaloupe. Project involves anti-missile defense, and studies at the facility will investigate effects in nuclear space explosion similar to those produced by the earth's magnetic field.

▶ Sud Aviation is building the Alouette III helicopter, a more powerful version of the Alouette II, with an 850-hp. Turbomeca Artouste III turbine engine. Initial production planning calls for 200 Alouettes, and French military orders are expected to supplement export orders.

▶ Japan will begin delivering Kappa solid-propellant research rockets to Yugoslavia next spring if the expected contract is signed between the Mitsui Bussan Co. and the Yugoslavian Space Assn. Yugoslavian engineers observed launches of Kappa 8 rockets from Japan last summer.

▶ Data analysis of Mercury-Redstone I flight shows its 15-mi. extra range came from high winds, from higher-than-expected performance—with maximum velocity increased from the estimated 4,200 mph. to 4,300 mph.—and from longer burning time—2-3 sec. more than the planned 141 sec. Winds originally were considered sole cause of the extra range (AW Dec. 26, p. 16).



EMBLEM OF STRENGTH, noted for its keenness of vision and range of flight, the American Eagle aptly describes the Navy's future long-range, air-to-air missile. EAGLE will mark a new era of anti-air warfare in which the high performance required is built into the missile itself rather than the aircraft that launches it. Development of the EAGLE anti-air warfare concept, for which we are prime contractor, offers new career opportunities for senior technical and management personnel.

BENDIX SYSTEMS DIVISION
ANN ARBOR, MICHIGAN

THE Bendix CORPORATION

Washington Roundup

NASA Will Create Man-in-Space Center

One of the first changes in the National Aeronautics and Space Administration in coming weeks will be the creation of a Manned Space Flight Research Center, built around the Space Task Group which now handles the Mercury and Apollo projects.

This will be an attempt to give the group an increase in personnel strength and a freedom that will allow it to take better advantage of technological developments in planning manned space flight for a period 15 to 20 years in the future.

Space Task Group was to have become a part of the Goddard Space Flight Center near Washington once the Mercury project was essentially completed. The plan now is for it to become an independent center, building gradually from 600 people to approximately 1,500, and remaining primarily a management group with few research facilities of its own. Location has not been settled. STG now is based at Langley Field, Va.

Recent visit of Pierre Salinger, President-elect John Kennedy's press secretary, to the Air Force Missile Test Center in Florida has given missile and space workers there considerable hope that Kennedy also will take a personal look at Cape Canaveral and its support areas. President Eisenhower did not visit the Cape until Feb. 10 this year, despite frequent golf and hunting trips to Thomasville, Ga., some 250 mi. away, and then he left a bad impression with many engineers by staying only three hours.

Space Launch Notice

Failure of an attempted space launching no longer will be the first notice to most of the public that the civilian space agency was trying another experiment.

After two years of officially refusing to discuss an impending shot until after lift-off—or explosion—NASA now will release information about a week ahead of each attempt. It believes the experimental nature of space launchings may get more emphasis in detailed prelaunch stories, with the result that the public will become more aware of what outgoing NASA Administrator Keith Glennan calls "the substantial inherent probability of failing to accomplish the full measure of hoped-for results."

NASA's former policy—formally withholding information until the day before a shot, and then issuing press kits marked "hold for launch"—was inherited from the Defense Department, where it didn't work either. This approach, intended to prevent a publicity "buildup" before a shot, was imposed by the Administration in the public relations panic that followed the spectacular explosion of a Vanguard test vehicle two months after Sputnik I was launched.

Central Intelligence Agency has been keeping a box score on Soviet Russia's rocket diplomacy or "ballistic blackmail." On more than 40 occasions since 1956, Russia has threatened 15 different countries with destruction by rockets carrying nuclear warheads.

In spite of Russia's recent claim that it has reduced its defense budget "considerably" for next year, CIA believes that the Soviets are spending about the same dollar amount as the U. S. is on military programs, that Russia will continue to build its war machine without being hampered by the cry for more consumer goods, and that this is reflected in an ever-increasing arrogance, typified by the rocket threats.

Foreign Activity Probe

Mutual weapons development and U. S. investments in foreign defense firms and facilities are being investigated by the staff of the House Government Operations Subcommittee on Military Operations, headed by Rep. Chet Holified (D.-Calif.). Hearings probably will be held early in the congressional session.

First report of the subcommittee, which pressed for reorganization of Space Technology Laboratories into a nonprofit company in 1959, will deal with Aerospace Corp. This is the company that was organized to help manage Air Force missile and space programs in lieu of an STL reorganization.

Staff report on the feasibility of integrated regulation, ownership and operation of various forms of transportation has been submitted to the Senate Commerce Committee, headed by Sen. Warren Magnuson (D.-Wash.), after more than a year of preparation.

Objections by religious groups have forced USAF to look for another code name for Project Saint, its proposed satellite interceptor. Those who oppose the name Saint say it should be reserved to religion, but is particularly irreverent and inappropriate when applied to a weapon system.

—Washington Staff

NASA, Defense Seek More Space Funds

Both agencies ask 50% increase in next budget; Johnson says military program to be strengthened.

By Larry Booda

Washington—Both the Defense Department and the civilian space agency have asked the Eisenhower Administration to request Fiscal 1962 space research and development budgets 50% higher than their requests for the current fiscal year.

Meanwhile, Vice President-elect Lyndon B. Johnson gave the first official indication last week that the Kennedy Administration intends to strengthen the military space program. This is significant in view of the battle looming between the services and the National Aeronautics and Space Administration over which will dominate the U. S. space effort and get the lion's share of the space budget.

Commenting on space program jurisdiction, Johnson indicated no definite decision has been reached, but he said: "The Defense Department has a very definite role and function in the field, which we recognized in the space act itself, and we must look to the services for leadership in space work. At the same time, we want a civilian head. We do have the NASA group, and we try to coordinate those two groups and get the maximum benefit from both."

Following talks with President-elect John F. Kennedy last week, Johnson estimated that total space spending for Fiscal 1962 will be approximately $2 billion, with progressions up to $5 billion by Fiscal 1965.

Defense recently approved and sent to the Budget Bureau requests for Air Force, Navy and Army space research and development projects totaling $657 million for Fiscal 1962. The original Defense request last year for new military space research funds was approximately $400 million.

NASA is asking $955 million next year, compared with a $621 million request for Fiscal 1961. NASA and the services together are asking a total of $1.612 million for space research and development. This does not include funds for salaries, expenses, construction and equipment categories in total budgets.

Largest single item in the combined space research budget request for Fiscal 1962 is $410 million for NASA for operations, vehicles, research, development, procurement and miscellaneous items. Air Force asked $15 million in this category, and it is for the Phoenix booster program (AW Dec. 19, p. 37).

Next largest category is $222 million requested by USAF for reconnaissance. This would go into the Samos satellite program, which is now moving on to the advanced E-6 version. Navy requested $1.1 million in this category for studies on its proposed Yo Yo single pass reconnaissance satellite (see p. 41).

NASA wants to spend $120 million on its communications satellite program, including the passive Echo sphere and the active repeater satellite planned for civilian communications. Army wants $82.3 million for the Courier and Advent active communications satellite programs.

For manned space flight, requests include $120 million for NASA's Project Mercury. Air Force initially asked $146 million for the Dyna-Soar program and $20 million for Aerospace Plane. USAF manned space flight budget was cut to $121 million, and it would have to cover these two projects. Navy requests less than $1 million for studies in this area.

For all space science investigations—those other than manned space flight and practical applications on weather and communications—NASA has requested $232 million.

DOD Requests

Other requests submitted by DOD are:

- **Early warning**—$92 million for the Air Force Midas infrared early warning satellite for detection of intercontinental ballistic missiles.
- **Astro defense**—$31 million for Air Force, probably most of it for the Saint interceptor satellite; and $5.3 million to Navy for project Skipper, a vertical probe space-mine.
- **Weather**—$30 million to NASA for further development of the Tiros and Nimbus weather observation satellites.
- **Tactical space vehicles**—$6 million to Navy for development of the Sea Scout ship-launched booster.
- **Navigation**—$22 million to Navy for development and operation of the Transit navigation satellite.
- **Geodesy**—Less than $500,000 to Navy for studies on how to resolve mapping errors by use of satellite observation.
- **Component research** and development—$100 million to NASA and over $1 million to Navy.

NASA earmarked $43 million for supporting space research activities, and Air Force allotted $56 million for overhead for management and other items.

After a conference in Palm Beach, Fla., with Kennedy on U. S. space problems, Johnson discussed the attitude of the incoming administration on the exploitation of space. He said: "The

British Financing Vulcan-Skybolt Work

Washington—Work on the mating of the USAF-Douglas Skybolt missile to the British Avro Vulcan bomber has been resumed, using money released from a $2.8 million British fund set aside in this country for support of the project.

USAF recently halted the work pending direct British financial support (AW Dec. 26, p. 24). Skybolt development is in danger of being stretched out by as much as six months unless at least another $35 million in USAF funds can be found, because USAF is having trouble supporting the project from Fiscal 1961 funds. Fiscal 1962 money for Skybolt also is in doubt.

Skybolt is being developed both for the Boeing B-52 and the Vulcan. Until now, USAF has funded the Vulcan adaptation work while negotiations were being conducted to determine the British share. The Vulcan work was being negotiated separately from the over-all missile project.

USAF's decision to withhold funds brought almost immediate release of the British money, but did not help already strained U. S.-British relations. The move is being referred to within the Air Force as an "administrative goof." The joint project has provoked considerable criticism in Britain on the grounds that it puts reliance for British atomic defense on a U. S. project that could be abandoned at any time.

Northrop Corp.'s Nortronics Division, which is developing the Skybolt guidance system, has laid off 650 employes because of the Skybolt stretchout. Douglas will lay off in the next two weeks 1,050 manufacturing employes directly concerned with Skybolt: 625 at Santa Monica, 260 at El Segundo, 40 at Long Beach and 310 at Tulsa. In addition, Douglas will lay off another 1,050 employes at Long Beach alone because of phase out of C-133B production and reduced DC-8 production.

President-elect wants that program reviewed with a fine tooth comb with a view of determining whether any money is being spent that shouldn't be spent, whether all is being done that can be done, and he is determined that America forge ahead and occupy her proper place of leadership in that field."

Johnson said that the space program review was now under way, but he did not say who was conducting it. Sen. Robert S. Kerr (D.-Okla.), who will take Johnson's place as chairman of the Senate Space Committee, participated in the Kennedy-Johnson conferences.

Kennedy named Johnson to be chairman of the National Aeronautics and Space Council. He did not say whether the scope and character of this group's operations would be changed. Other members will be the Secretary of Defense, the Secretary of State and the NASA administrator.

Glennan Resigns as NASA Administrator

Washington—Keith Glennan resigned as administrator of the National Aeronautics and Space Administration last week, effective Jan. 20 when President Eisenhower leaves the White House.

Glennan will return to presidency of Case Institute of Technology. Dr. Hugh L. Dryden, deputy NASA administrator, might be asked to remain with the agency after Jan. 20 to provide continuity in the program and in budget hearings. Glennan and Dryden's offices are the only two presidential appointments at NASA.

Dryden, 62, has been a government scientist and engineering administrator for 42 years. In his letter of resignation to President Eisenhower, Glennan praised Dryden for his effectiveness in NASA's management.

Glennan sent the White House a summary of space accomplishments since NASA was established Oct. 1, 1958, including a revised long-range program. Among significant additions to the original long-range plan, submitted a year ago, are flight qualifications of the 1.5 million lb. thrust F-1 engine in 1965, launch of a real time active communications satellite for civilian use in 1963 and flight test of the Rover nuclear rocket engine in 1966-67.

Mirage III Selected As Swiss Fighter

Berne—Swiss government, belatedly acceding to military requests, will ask parliament to provide funds for the licensed production of 100 French Dassault Mirage III-C aircraft to close out the protracted debate over selection of a new fighter for the Swiss air force.

Government, which had turned down the military's request for the Mirage on at least two previous occasions because of political considerations, agreed to the proposal during discussions here last week.

At the time, the three-year-old competition had been narrowed to the Mirage and Sweden's Saab J35-B Draken, both of which were demonstrated to Swiss military and political leaders last month at Emmen (AW Dec. 19, p. 33). The decision also followed an Australian order for the Mirage III (AW Dec. 19, p. 37).

Parliamentary approval of the move and appropriation of the estimated $125 million needed to get the program under way, including the purchase of at least three prototypes directly from France, probably will be sought during the next session of the legislative body in March.

Initial contract may be followed within the next two years by an agreement for the licensed production of an additional 100 Mirage IIIs in Switzerland.

Prime contractor in the production effort will be the Federal Aviation Factory (Eidgenoessisches Flugzeugwerk Emmen), but a government spokesman said last week the "whole Swiss aviation industry will participate" in the program. Final details of the production effort will be laid out after parliamentary approval.

Prior political objections to the Mirage had centered largely around the fact that France is a member of the Inner Six economic community whereas both Sweden and Switzerland belong to the rival Outer Seven. The Mirage sales campaign, however, had strong backing from the French government, which is understood to have offered to ease its restrictions on imports of several Swiss commodities – including watches and chemicals—in return for an order. It also may pave the way for a long-sought air bilateral agreement between the two countries, which has been pushed by Swissair.

Mercury Costs Might Exceed $500 Million

Washington—Ultimate cost of Project Mercury might exceed $500 million, including Defense Department support valued at more than $82 million, according to a progress report prepared by the House Science and Astronautics Committee.

The report expressed complete satisfaction with the National Aeronautics and Space Administration's Mercury program and singled out for praise or explanation these areas which have been criticized earlier:

- **Slippage,** which the committee does not consider out of line in comparison with other complex research and development programs. Failure to meet established flight test schedules is explained by the research and development nature of the program.
- **Coordination** between NASA and the Defense Department, called "outstanding in every respect. Both organizations are dedicated to the success of this country's only current man-in-space program."
- **Value,** described by the committee as scientifically essential for Apollo, Dyna-Soar and future manned space flight. "Although decisions on the capsule and boosters were made several years ago, technology has not advanced to the extent of overtaking the basic Mercury concept. . . ."

The report was written by Navy Capt. H. J. Silberstein, staff consultant, and it contains the first comprehensive cost estimate of Defense Department support for Mercury.

Defense support through seven Redstone and eight Atlas launchings is estimated at $82,347,000. Of this, NASA will reimburse $64,794,000, and the services will absorb $17,533,000. Navy will absorb most of this cost in operation of its recovery force. Cost of recovery service is valued at $18.3 million, of which NASA is paying $5.1 million.

Air Research and Development Command support is valued at $57.7 million, including $54.4 for boosters and services from the Ballistic Missile Division, $3.2 million in range services at the Missile Test Center, and $130,000 for services by the Air Proving Ground Center. Defense is absorbing $2.26 million of the estimated ARDC cost.

Other major military support for Mercury:

- **Defense bio-astronautic** activities, operational and research, valued at $1.98 million. Services will absorb $1.39 million of this cost.
- **Pacific Missile Range,** services valued at $1.5 million, of which NASA is paying $1.2 million.
- **USAF Air Rescue Service,** for which NASA is paying all of the $1.4 million estimated cost.
- **Military personnel** detailed to NASA's Space Task Group, for which NASA is paying all of the $290,000 cost.
- **White Sands Missile Range** services, for which NASA pays all but $100,000 of the $660,000 cost.

Other support comes from the Aeronautical Charting and Information Center, $185,000; Army amphibious recovery vessel services, $114,000; and government furnished equipment, $166,000.

Broader Planning Role Seen for Defense

By Ford Eastman

Washington—More active role for the Defense Department in atomic energy and foreign policy planning is indicated by the background of men named to top Pentagon posts by President-elect John F. Kennedy.

Defense officials chosen last week include Eugene Zuckert, Washington attorney and former Air Force assistant secretary and Atomic Energy Commissioner, as Air Force secretary; John B. Connally, Ft. Worth lawyer and former legislative assistant to Vice President-elect Lyndon B. Johnson as Navy secretary, and Paul Nitze, defense and foreign policy expert and former financier, as assistant defense secretary for international security affairs.

Earlier, Kennedy had named Roswell Gilpatric, who also has had wide experience in both the defense and foreign policy fields, deputy defense secretary (AW Dec. 26, p. 21).

In picking his top Defense aides, Kennedy appears to be following closely the recommendations made by Sen. Henry Jackson (D.-Wash.), chairman of the Senate Government Operations Subcommittee on National Policy Machinery of the Democratic National Committee.

Sen. Jackson said "a full and welcome partnership of the Departments of State and Defense is the prerequisite of coherent political-strategic counsel for the President" to help him fulfill the obligations of his office.

Since he served as chairman of a committee which prepared a report for Sen. Kennedy on national security problems, Nitze probably will have the most active role in coordinating defense and foreign policy planning. Gilpatric also served on the committee. Nitze will be responsible for liaison between Defense and State on disarmament problems and responsible for direction of military assistance programs, and he will have responsibility for the department's relations with the National Security Council and the Operations Coordination Board. Announcing the appointment, Kennedy said Nitze would play a key role in developing new disarmament plans.

Nitze joined Dillon, Reed & Co., a New York investment firm, in 1929 and became vice president before he left to operate his own financial consulting organization in 1938. In government, he has served since 1939 as financial director, Coordinator of Inter-American Affairs; chief of metals and minerals branch, Board of Economic Warfare; director of foreign procurement and development branch, Foreign Economic Administration and as special consultant to the War Department.

From 1944 to 1946, he was vice chairman of the U. S. Strategic Bombing Survey where he was awarded the Medal for Merit, and in 1946 he was deputy director of the State Department Office of International Trade Policy. In 1948 and 1949, he was deputy to the assistant secretary of state for economic affairs, and in 1950 he became the director of the State Department's policy planning staff.

Nitze was born in Amherst, Mass. Jan. 16, 1907, and is a Harvard University graduate. He is president of the Foreign Service Educational Foundation and trustee of Johns Hopkins University.

Zuckert also has a long record of government service, starting in 1937 when he became attorney for the Securities and Exchange Commission. From 1940 through 1944, he was an instructor in relations between government and business at the Harvard Graduate School of Business Administration, advancing to assistant professor and later assistant dean of the school. During this period, he also served as administrative head of the first advanced management course ever given at the Harvard Graduate School.

While a member of the Harvard faculty, Zuckert served as a special consultant to the commanding general of the Air Force in developing statistical controls. He was an instructor in the Army Air Forces Statistical Control School at Harvard, which trained more than 3,000 Air Force officers, and he has served at various Air Force bases on special assignments for the Air Force's commanding general.

In 1944 and 1945, Zuckert served in the office of the Chief of Naval Operations as a lieutenant (jg) in connection with the Navy's inventory control program. In 1945, he became executive assistant to Stuart Symington, who was then administrator of the Surplus Property Administration. When Symington became Assistant Secretary of War for Air in 1946, Zuckert became his special assistant, and he was named assistant secretary of the Air Force when Symington became its first secretary in 1947. In 1948, Zuckert served on a committee established by Defense Secretary James Forrestal to write a unified court martial code for the military services.

From 1952 to 1954 he served as a member of the U.S. Atomic Energy Commission, and since then he has been an atomic energy consultant and attorney. Zuckert is chairman of the board of Nuclear Science and Engineering Corp., a company in the field of radiation chemistry, and a director of AMF Atomics of Canada, the atomic energy subsidiary of American Machine and Foundry, Inc. Zuckert was born in New York City Nov. 9, 1911 and received a Bachelor of Arts degree from Yale in 1933. He received his Bachelor of Law degree in 1937. Zuckert is associated with the law firm of Lear and Scoutt.

Connally, who served in the Navy during World War II, specialized in

Army Cancels Republic SD-4 Drone

Army canceled the Republic SD-4 Swallow supersonic reconnaissance drone project last week, indicating development will continue on the Fairchild SD-5 subsonic drone which has longer endurance. Both are powered by the Pratt & Whitney JT12 turbojet engine.

The Fairchild project will undergo a periodic Signal Corps technical review this month that will include funding. Since the SD-5 is now the only candidate in its mission category and has been making good progress, Fairchild is optimistic about its future.

Republic will lose the $5 million not yet spent on the project in Fiscal 1961 funds plus the potential production value the program may have carried. The SD-4 was the main hardware project of Republic's Missile Division, and 100 production workers will be laid off at the end of a plant-wide vacation Jan. 9. Total employment at the division is 500, but many will be retained for study programs under way at the division or in other divisions of the company.

Two SD-4s had been built and first flight had been scheduled for this month. Army does not plan to fly either one now. To date, $34 million has been spent.

Army gave as reasons for the cancellation: increasing costs of the SD-4 system, need for these funds in other programs, and progress made in other drone programs. Aerojet-General is developing the piston-powered SD-2 surveillance drone, which also still is funded.

Both the Fairchild and Republic drones are at Ft. Huachuca, Ariz., where the Fairchild drone made its first flight last May. In the latest of five flights, the SD-5 remained airborne 3½ hr. One of the five was a launch failure, and in another a recovery parachute failed though the flight was successful otherwise.

law and politics during most of his career. He was assistant to Vice President-elect Johnson from 1939 to 1941 when Johnson was a member of Congress from Texas. In 1948, he became Johnson's senatorial campaign manager and served as administrative assistant briefly after his election. Early this year, he served as national manager for Johnson in his unsuccessful bid for the Democratic presidential nomination. After the convention, he worked for the Kennedy-Johnson ticket.

Navy Veteran

The 43-year-old attorney entered the Navy as an ensign in 1941 and was assigned to the office of Secretary Forrestal. Later he was assigned to sea duty aboard the carrier Essex as a fighter aircraft director, and he served in the same capacity aboard the USS Bennington. He was awarded the Bronze Star for service aboard the Essex and the Legion of Merit with a combat "V" for service on the Bennington.

When he left the service as lieutenant commander in 1946, Connally helped organize and operate radio station KVET in Austin, Tex.

As a lawyer, Connally represented the Richardson & Bass oil firm and became executor of the estate of Sid Richardson, wealthy Ft. Worth oilman. He was born in Floresville, Tex. and received his law degree from the University of Texas.

Discoverer to Carry More Life Specimens

Vandenberg AFB—Air Force Discoverer XX satellite is scheduled to be launched here shortly after Jan. 15 carrying additional biological specimens for analysis of space environmental effects after capsule recovery.

Discoverer XIX, largely instrumented to determine basic earth-atmosphere infrared background for use in the Ballistic Missile Division's Midas early warning satellite program, lost transmitting power on its 75th pass during the fifth day of its orbit around the earth. One additional day of data transmission was thus provided, since Discoverer programmers had not expected battery life to extend beyond four days.

Tracking was suspended after telemetry was lost.

No recovery of the Discoverer XIX capsule was planned because data was to be telemetered, and no biological specimens were included. During the fourth day of orbit, Discoverer XIX's attitude control gas was exhausted and the satellite was rolling on both longitudinal and lateral axes at one revolution per minute, but this did not interfere substantially with the data transmission.

Allison T63 Turbine Passes First Trial Run in HUL-1M Testbed

Hurst, Tex.—First airframe installation of the 250-shp. Allison T63 turbine, expected to play a significant role in the Army's light observation helicopter (LOH) competition, has successfully passed its initial three-hour "green run" during ground test in a Bell HUL-1M helicopter.

If the HUL-1M testbed successfully passes its 20-hr. tiedown trial period, next phase will be actual flight trials, which may take place later this month. Having pioneered first installation of the new turbine engine, Bell Helicopter Corp. engineers are anxious to be first to fly it in an airframe.

Two Bell Model 47J helicopters were purchased off-the-shelf by the U. S. Navy and converted by the company to take the T63 for testbed trials. The first aircraft, now being tested, will probably remain at Bell for the major portion of the engine evaluation program. The second is scheduled to be delivered to Allison Division of General Motors Corp. for engine installation.

Navy has been interested in application of the powerplant to its training helicopters and also for shipboard use, but the major role for the new powerplant is seen as powering the Army's projected requirement for 3,500-4,000 light observation helicopters (AW Sept. 5, p. 30).

Bell is one of the contenders for this prize and considers the opportunity to collect installation and operational experience with the powerplant at this stage of the game invaluable. Engineers here consider the step of getting the T63 into an airframe an important milestone in the LOH program. The company already has built a closely-guarded mockup of its LOH entry.

Indications are that Bell engineers feel that their installation of the T63 would be most beneficial if the powerplant is inverted, putting the air intake at the top for better airflow access, also obviating the need for a jog in the shaft takeoff for the tail rotor. Installation would make it possible to cut the length of the main rotor mast, improving its torsional stability. Oil tank would be removed from the top of the engine where it is now and probably be placed to the rear of the engine, providing easier access to the powerplant and also reducing its silhouette.

Current installation in the HUL-1M is made with minimum modification so as to speed gathering of installation and operational data.

HUL-1M project engineer J. R. Duppstadt reports that no difficulties were encountered in installing the YT63-A-3 powerplant, and during the initial run, the engine ran "sweet." The upcoming 20-hr. tiedown run will be completely instrumented to provide data on engine and transmission stability, fuel pressure, burner chamber pressure and other check points.

Powerplant embodies six axial stages and one centrifugal stage and two turbines, each with two stages. Powerplant is rated at 250-shp. but is actually a 300-shp. engine at 100F ambient. It weighs only 128 lb. This installation on the 47J compares with approximately 440 lb. for the piston-engine Lycoming VO-540 installed in the 47J-2 and approximately 400 lb. for the Lycoming VO-435 installed in the 47G-2A.

Turbine Indications

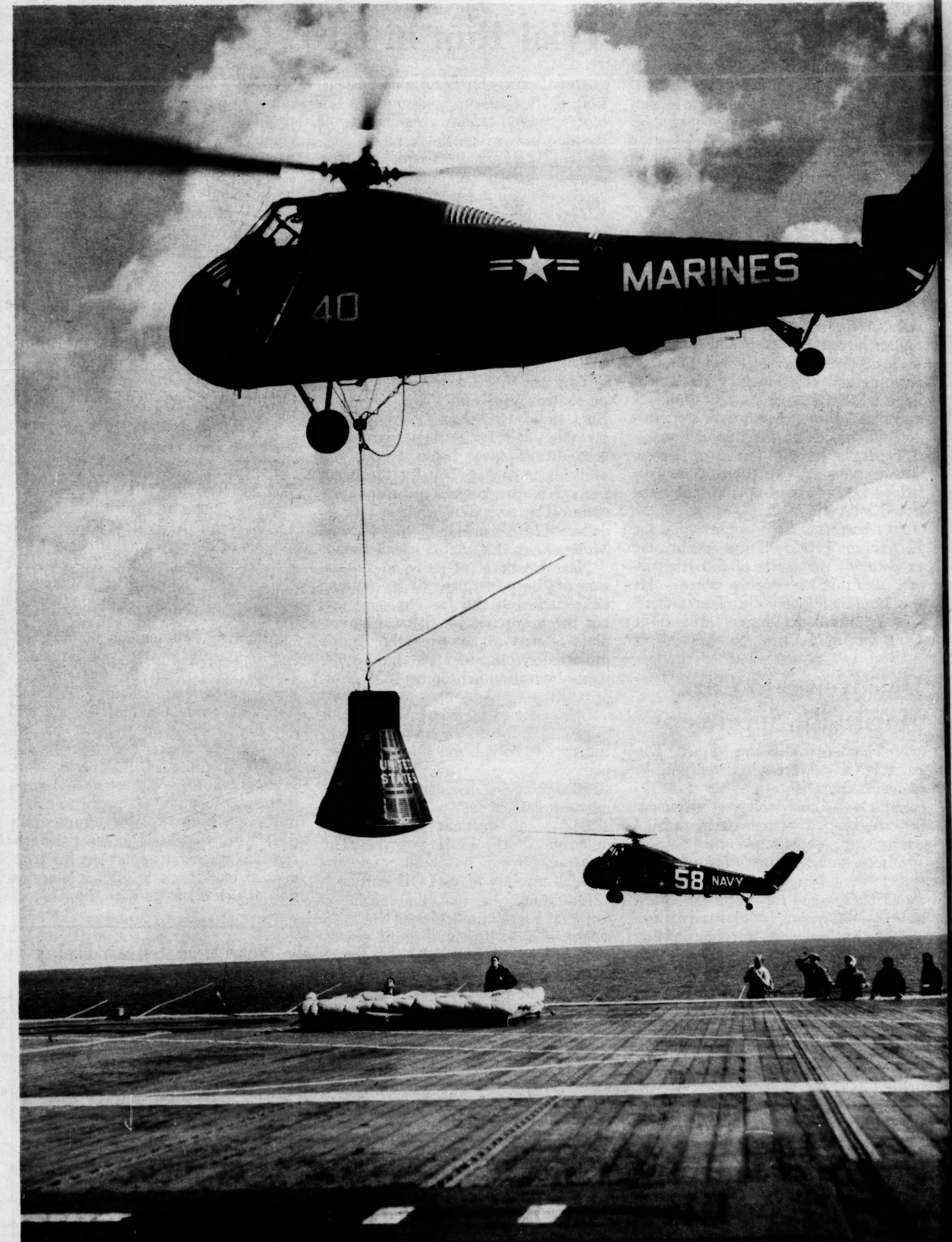
Paperwork indicates that with the T63 installed the HUL-1M will have a service ceiling of 18,000 ft. as against 12,100 ft. for the 1961 47J-2 with gross weights of the two aircraft being 2,850 lb. Useful load of the T63-powered HUL-1M is calculated at 1,500 lb. as against 1,120 lb. for the piston-powered 47J-2.

Although Bell officials do not conjecture openly on the possibilities of tieing the T63 to the present line, probably because delivery dates and prices of production engines are still not firm, indications are that the engine should have commercial possibilities because of the performance gains it affords. The company could follow one or more of several routes in utilizing the new power commercially if it wins the LOH competition, to consider placing its entry on the commercial market, or to offer a later version of the 47J fitted with the T63.

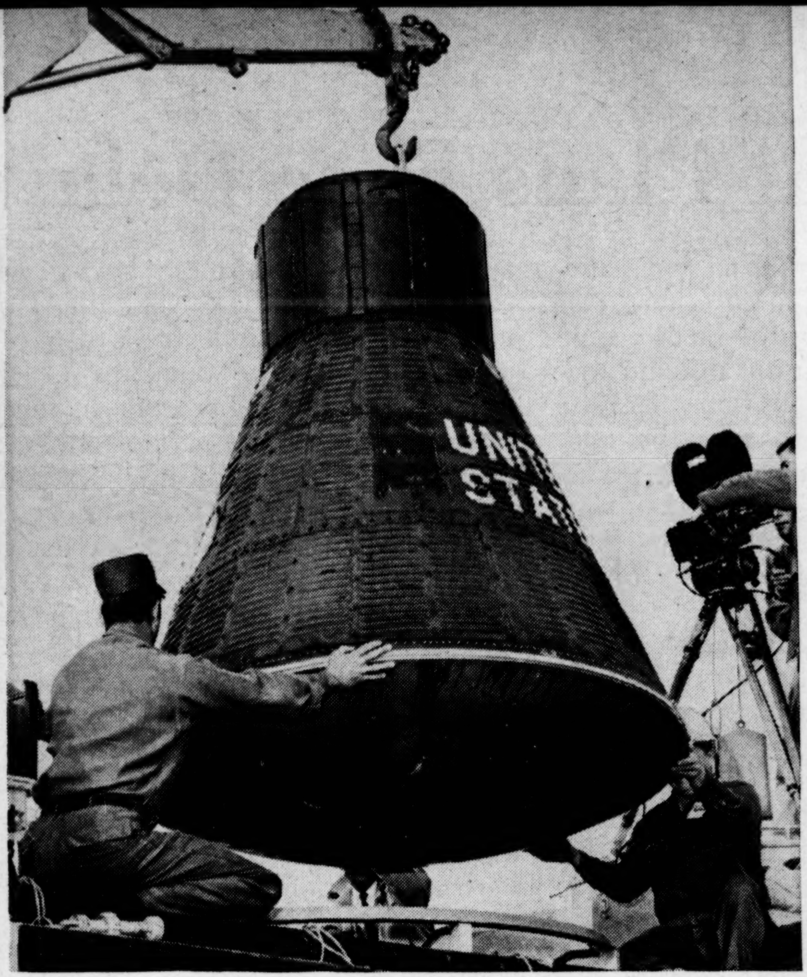
New Minuteman Delay

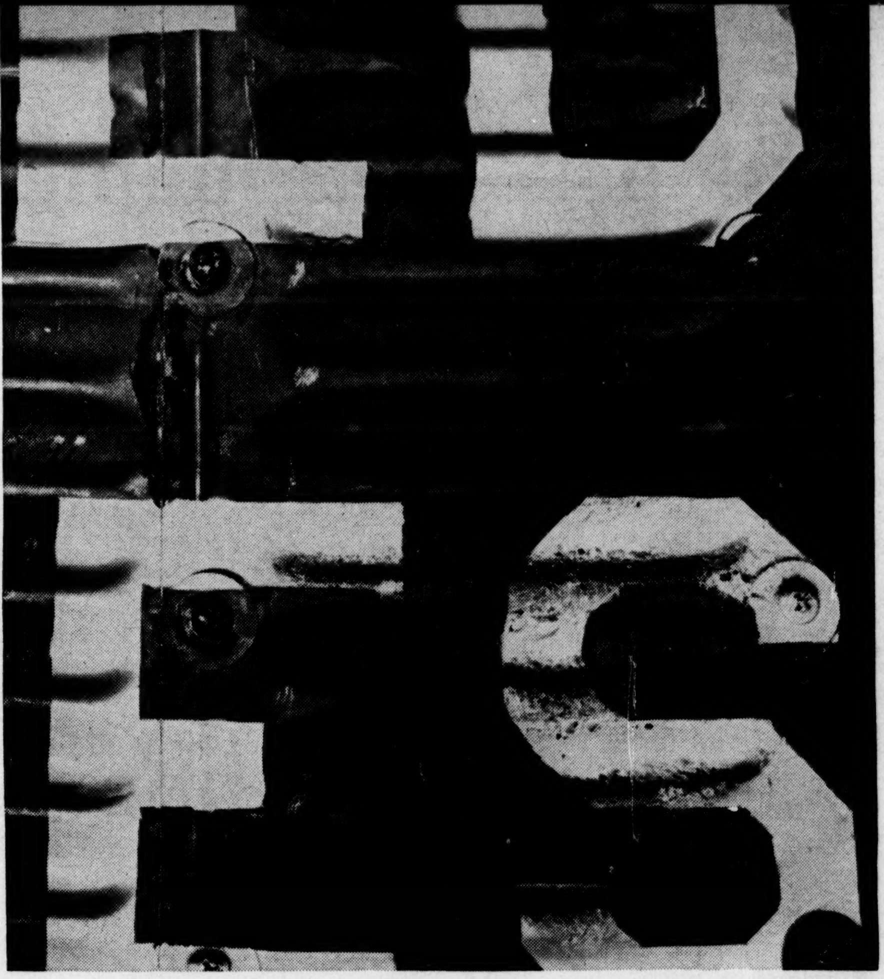
First firing of the Air Force Ballistic Missile Division's Minuteman three-stage, solid-propellant intercontinental ballistic missile probably will not be attempted before Jan. 15 from Cape Canaveral. Programed to achieve an ICBM-range, this initial launch will be for considerably less than the potential full design range of the missile because of the quantity of research and development instrumentation which will be carried.

Delay from the previously scheduled launch date late last month (AW Dec. 19, p. 30) has been caused by difficulties with ground checkout equipment and control and monitor prelaunch test operations.


MARINES
40
UNITED
STATES
58 NAVY

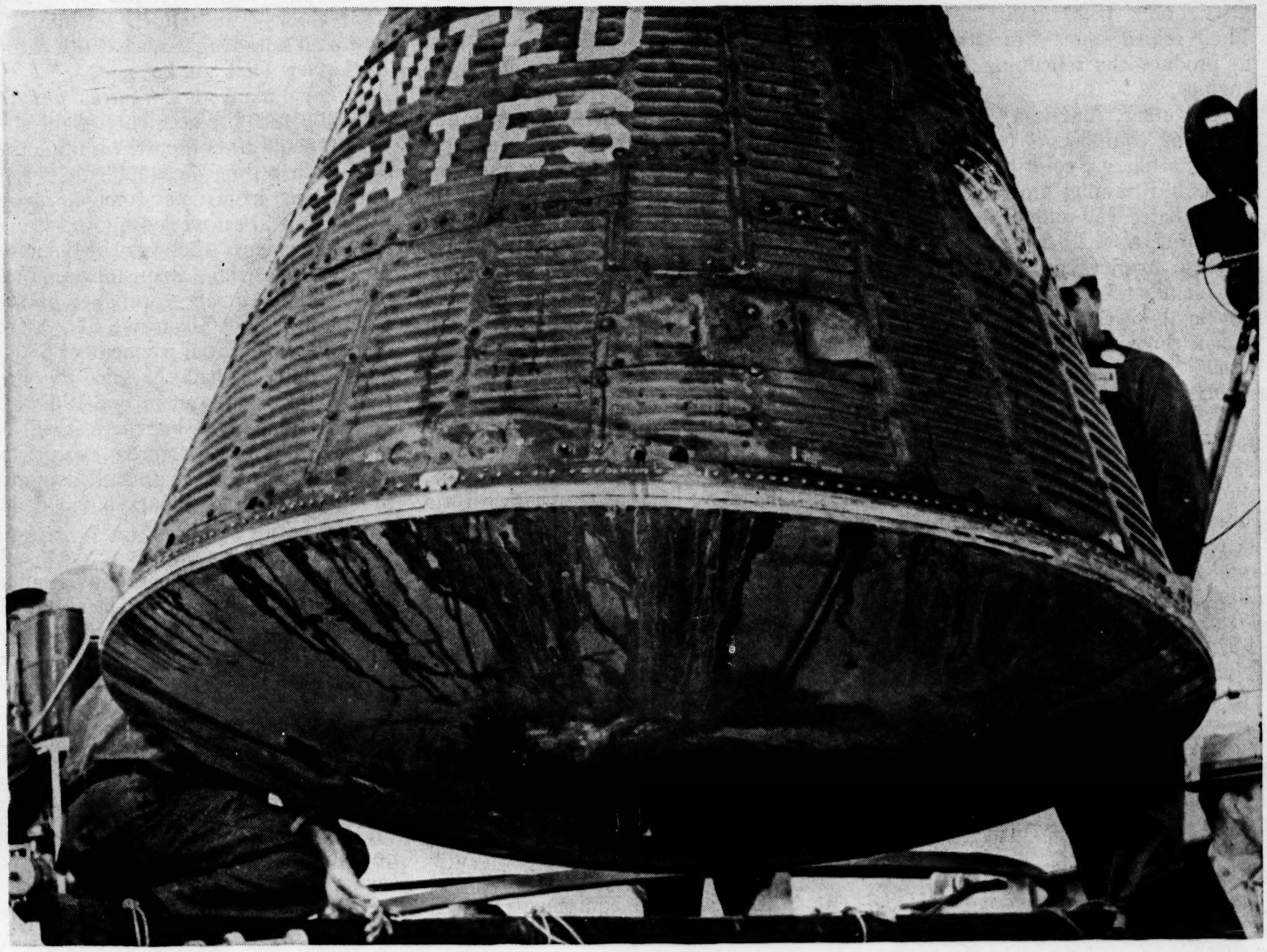
Recovered MR-1 Mercury capsule is shown being lowered onto the deck of the USS Valley Forge by Marine Corp. HUS-1 (Sikorsky S-58) helicopter following pickup approximately 235 mi. downrange from Cape Canaveral, Fla.





Recovered Mercury Capsule Received Only Minor Damage

Only apparent damage received by Mercury capsule which made flight Dec. 19 (AW Dec. 26, p. 16) was broken outer layer of three-layer heat-resistant glass in one porthole (right center, below). Above left, capsule is positioned on Army amphibious vehicle. Paint on letters S and E in United States on Mercury capsule (above right) is blistered but NASA said this was not significant because this paint has a low blistering temperature. Streaks on heat sink (below) are dye marker stains and not result of heating.



Japanese Rearmament Plans Face Delays

Tokyo—Japanese Self Defense Agency—the only military organization permitted under the MacArthur no-war constitution—is worried that its rearmament plans may be further delayed by Washington's new save-the-dollar policies.

Already moving at a snail-pace, Japan's efforts to create modern defense forces against the growing power of Communist China have been held up by opposition of the neutralist Socialist Party. But building of a respectable air, navy, and land tactical group—totaling about 140,000 men—has slowly moved ahead in the past five years with considerable U. S. aid.

Most of the U. S. aid has been in the form of equipment—"grant aid"—to the Japanese forces. But, increasingly, the Japanese have been looking to the U. S. to supply part of the financing to get the Japanese defense industry back on its feet.

The project to re-equip the Japanese air arm with F-104Js, for example, will be jointly financed by the Japanese and the U. S. The total project in the initial three-year stage will cost $207 million. About $75 million of this will be met by the U. S. by supplying 20 U. S.-built F-104B trainers and J79 engines for the first 30 or 40 planes under the program. Then Ichikawajima Machinery Co. is to produce the remaining 170 or 160 engines.

Altogether American "grant aid"—including components for tanks, small arms, artillery, contributions toward ships, and training programs—will total an estimated $50 million in Fiscal 1961 beginning Apr. 1, officials of the Self Defense Agency said. This figure does not include the $75 million "grant aid" for the F-104 program to be prorated over a three-year period beginning last year.

The SDF has asked the Finance Ministry for a total of about $513 million for Fiscal 1961 in budget recommendations sent forward last month. But the SDF and other observers expect this figure to be trimmed back as it has been in previous years to about 10% of the total national budget. Although American planning has assumed that the Japanese would be willing to pick up a greater share of their own defense costs (they now run between 2½ and 3% of the gross national income), the pattern of a fixed percentage of the national budget rising only as rapidly as the government's over-all expenses seems to have become the accepted principle on which Japanese conservative politicians are working.

Observers are divided in their opinion of what will happen if the U. S.—because of the gold drain—now seeks to cut its contribution to Japanese defense. The Liberal-Democratic government of Prime Minister Hayato Ikeda came back this month with an absolute majority over the opposition Socialist Party. But it failed to gain the two-thirds majority which would be necessary to amend the constitution and strike out the "no war" clause. Furthermore, the Socialist Party gained an additional 23 seats—largely at the expense of the anti-Communist minority right-wing Social Democratic Party. Within the Socialist Party the extreme leftist forces increased their strength.

All this seems to add up to a very cautious policy on defense, as on other issues, for the Ikeda cabinet in the months ahead. Ikeda is known as a tough politician and a stubborn advocate of a pro-Western orientation for Japanese foreign policy. But it is not likely that he will want an all-out battle with the Socialists over the defense budget in the upcoming session of the Diet (parliament).

American observers in Tokyo point out that there is no reason, per se, for the American contribution to the Japanese build-up to be trimmed. Most of the U. S. contribution has been in U. S.-made equipment.

Industrial Potential

But, increasingly, Japanese defense officials and important sectors of industry—aircraft, for example—have tried "to sell" the defense program to the Diet and the public on the basis of its creating industrial potential for Japanese industry. For example, American offshore procurement of vehicles for South Viet-nam, Korea, and Taiwan has accounted for a big part of the total production of the Japanese automobile industry, and has permitted it to remodel and expand its facilities to lower unit costs and meet the demands of the Japanese civilian car market.

One project which the SDF and U. S. planners have been playing with is for a revamping of the present early warning system in Japan. Japanese installations of the U. S. Fifth Air Force based in Japan and the Self Defense Forces (which have been taking over radar installations on a planned basis) are outdated and consist now of base surveillance units with a scanning area of only 300 to 350 mi.

Japan's Nippon Electric Co., an affiliate of International Telephone and Telegraph, has made some major advancements in over-the-horizon radar. It would be easier to sell the re-equipping of the Japanese system to the Diet if NEC made the equipment with a cash contribution from the U. S., rather than the Japanese buying new equipment in the U. S. Also the Japanese believe their industry is now prepared to meet the demands of the American military aid program in Southeast Asia, or at least part of it. Were Japanese defense industries set up—through contributions from the U. S.—to meet some of the third country requests for equipment under the U. S. Military Aid Program, the Japanese argue it would be easier to talk the Diet into buying the same equipment for the SDF.

One project that may be dropped if there is any American cutback is an anti-submarine helicopter carrier on which the Japanese were planning to start construction in Fiscal 1962. This year's budget proposal contains a small item covering initial planning for the carrier.

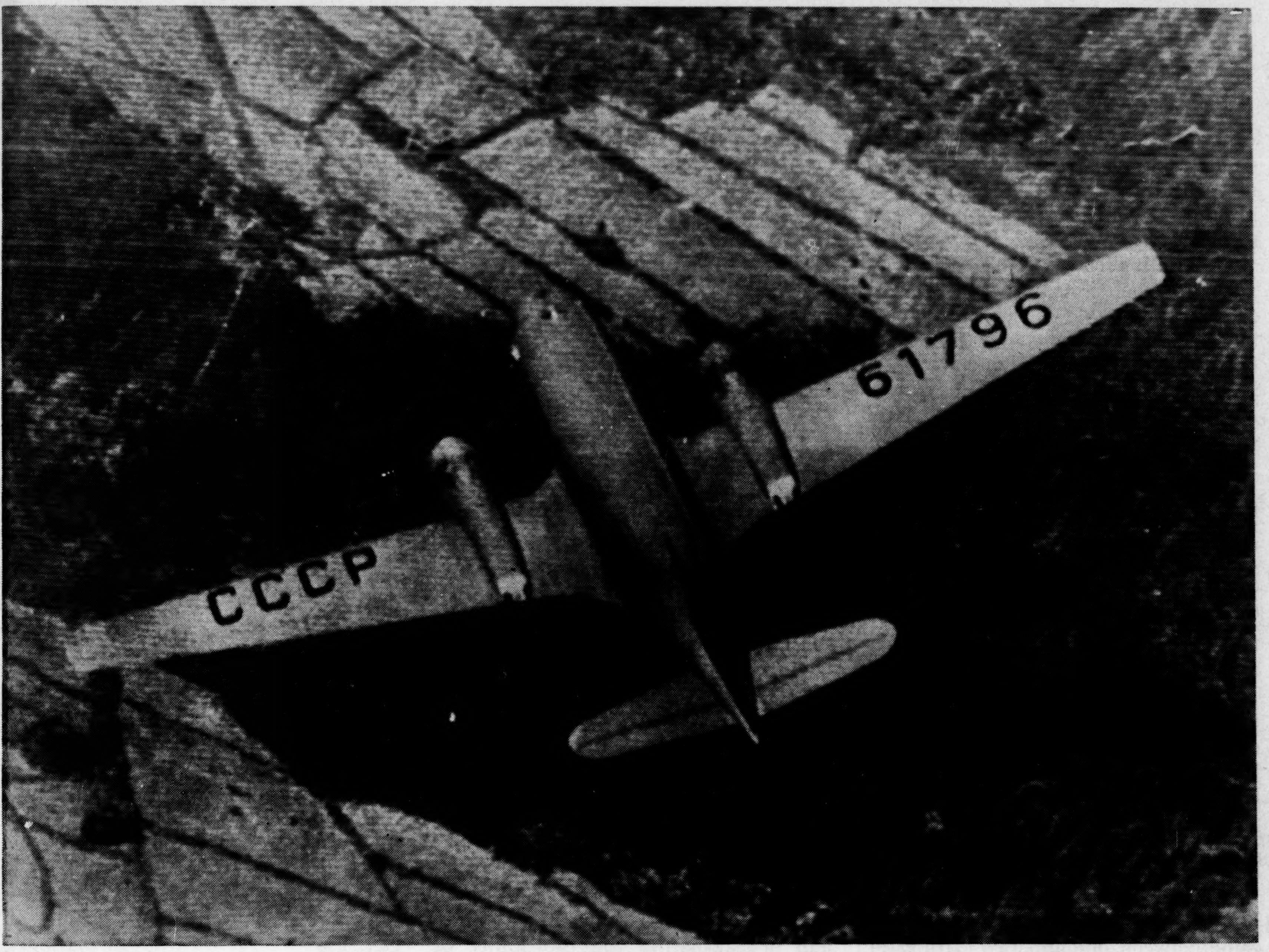
The Finance Ministry has already let it be known that it opposes the project because the SDF has not come up with an over-all program of expansion. An original five-year plan for expansion was dropped after the Kishi government fell in mid-summer during the Socialist-sponsored demonstrations against the U. S.-Japan Security Pact. The SDF joint chiefs have refused to submit a new plan until they see what the nature of the new Diet will be.

Original plans for the carrier were for a 10,000 ton displacement weight ship which would be equipped with Sikorsky S-61 twin turbine helicopters.

Finance Ministry's foreign investment council last week approved licensing agreements between Mitsubishi Heavy Industries, Reorganized, Ltd., and United Aircraft to produce domestically 50 30-seat Sikorsky S-61s. Agreements involve initial payment of $500,000 royalty. Mitsubishi said the first few S-61s coming out in mid-1962 will be reassembled here but the rest will be domestically manufactured except for avionic equipment. Estimated domestic production cost is about $600,000 per unit.

If the SDF's budget is severely cut, the program to give Japan one battalion of Nike-Ajax units may also be scrapped. The SDF planned to purchase those outright in the U. S. next year and move toward Japanese manufacture in the future. Also the Japanese had hoped to buy the electronics equipment in the U. S. for a guided missile destroyer unit.

One basic problem of the SDF is the high cost of personnel expenditures in the total budget of the force. Wages now account for more than 60% of the agency's total expenditures. Recruits are being paid about $15 a month, which is considered a very high figure



Soviet Ilyushin Il-14 Shown Over Laos

Russian Ilyushin Il-14 twin-engine transport with civil markings is shown flying over Laos, about 30 mi. north of Vientiane, a Laotian city 80 mi. south of Luang Prabang, the capital, on Dec. 21. It reportedly was used to parachute weapons and supplies to pro-Communist rebel forces at Vang Vieng, 65 mi. north of Vientiane, after the rebels were driven from the capital.

in Japan, in order to compete against the higher wages now being offered by booming Japanese industry.

Some high officials in the SDF are calling for a drastic reduction of personnel if the Agency's budget is cut back, arguing that an elite force with excellent equipment is more important than meeting the total of 160,000 men now permitted by the legislation which set up the SDF.

There has been no fixed ratio of American contributions to the Japanese build-up, depending on the particular project. For example, in naval construction, it has usually been about 8% American to 92% Japanese because of the high degree of efficiency and technology in the Japanese shipbuilding industry. In the F-86 program concluded last year, the U. S. met the costs 50-50.

One plan set forth by the Japan Ordnance Assn., a federation of defense industry companies, is that at least a portion of the Government Assistance & Relief to Occupied Areas repayment be diverted to the defense build-up. Theoretically, the Japanese owe the U. S. some $2 billion for American aid extended in the immediate postwar period. The foreign minister (not yet named) in the new Ikeda government expects to take up this problem when he visits Washington some time early this year.

Under the renegotiated Japanese-American security treaty signed last summer, the U. S. gave up the Japanese contribution toward support of American forces in Japan. It had amounted to approximately $155 million annually. Assumption was that Japan would pick up a larger share of its own defense costs in exchange.

The Japanese Foreign Ministry is committed to repaying the debt. It is assumed in Tokyo that because of the current gold drain, there will be enormous pressure in Washington to have at least part of the debt repaid in dollars.

But the Japanese would like to see part of it used in yen—either as contributions toward Japanese public projects including defense, or toward American purchases of Japanese manufactured goods for third countries.

Solar Flares Raise Atmospheric Density

Washington—Solar flares apparently affect the earth's atmosphere by increasing its density, according to a theory developed by the National Aeronautics and Space Administration as a result of a shift in the Echo I orbit during the intense solar storm Nov. 12.

Extremely small drag on the sphere doubled during the life of the storm and increased the orbital period for the 100-ft. satellite by two seconds each day. Echo passes through the outer Van Allen radiation belt, and NASA believes solar particles fed into the belt heated the atmosphere in that area and increased its density.

Echo was launched Aug. 12, and after 12 days in orbit, scientists in the U. S., Britain and West Germany theorized that the orbit is affected by solar pressure. Atmospheric density has changed the orbit of the sphere from its initial 945-1,049 mi. perigee and apogee to the current altitudes of 619-1,334 mi.

Dust Belt May Control Proton Intensity

New York—Existence of a terrestrial dust belt, rather than the limited strength of the earth's magnetic field, may be the controlling factor determining the intensity of trapped radiation-belt protons.

Controlling effect of the dust belt, a layer of micrometeorites which begins to have appreciable density about 4,000 km. (2,500 mi.) above the earth's surface, was postulated by Prof. S. F. Singer, University of Maryland, in a report delivered to the American Astronautical Society at its lunar flight symposium here last week.

Singer said the density of the dust belt, which increases to a maximum near the surface of the earth, may actually exceed that of the atmosphere near the 4,000-km. level. Because of this, he said, the particles of dust ". . . may have a profound influence on the radiation belt."

These protons trapped in the inner radiation belt are most likely to have originated with cosmic-ray albedo neutrons, and their intensity is controlled largely by the density of the ambient atmosphere. Normally this would mean their intensity would increase continuously with altitude.

But early predictions were made that proton intensity would show maximum value between one and two earth radii, based on the limited ability of the earth's magnetic field to hold the high-energy protons. This variation of intensity has been verified experimentally, Singer said.

Only contention is which is the controlling factor in the intensity of the protons: earth magnetic field or the dust belt. Singer pointed out either is possible, but his explanation was plausible and could be considered the first explanation from the viewpoint of logic.

It would require about 20 psf. of carbon shielding to protect the crew of a manned spacecraft against the inner-belt proton radiation, according to a report written by T. G. Barnes, E. M. Finkelman and A. L. Barazotti of Grumman Aircraft Engineering Corp. That amount of shield would also protect the crew against solar flares of normal intensity, but would not nearly meet the requirements posed by a solar flare of the magnitude observed in May 1959.

To shield against another flare of that intensity would require about 5,000 lb. of shielding per man, a weight intolerable for state-of-the-art spacecraft. Consequently, said the Grumman engineers, radiation protection is one of the most influential factors in spacecraft configuration selection. They showed a cross-section of a proposed two-man lunar vehicle, studied as part of a general approach to an Apollo-type mission, which included a hazard compartment inside a double-shelled, spherical liquid oxygen propellant tank.

Since the radiation problem can't be licked in the case of large solar flares, the next best thing is to avoid the problem. That brings up the problem of calculating the probability of encounter with a solar flare. While actual probability figures are relatively low—on the order of a few per cent for a seven-day lunar round trip—they are high enough to pose problems in planning and navigation.

Flare prediction may be feasible, said the Grumman team, citing the work of Dr. K. A. Anderson for National Aeronautics and Space Administration. Anderson's criterion, developed after careful study of 1,200 drawings of the sun's face made daily over a three-year period at the Athens, Greece, observatory, was useful in anticipating flares by about two days. But this technique probably can't be used to extend predictability beyond about four days.

If this can't be done, manned operations beyond the earth's magnetic field become a matter of applying games theory to solar proton encounter probabilities.

AAS/ARS Merger Negotiations Stalled

New York—Merger negotiations between the American Astronautical Society and the American Rocket Society still were stalled last week as the AAS met here.

Final counter-offer has been made by the ARS, but one official of AAS told Aviation Week that there was no society commitment to study the offer for either acceptance or rejection.

While official hope is still held for a merger, individual members of both societies feel that the cause may be lost. American Rocket Society has authorized negotiations to continue until the annual meeting of the AAS later this month.

Major contention that prompted the ARS "final" counter-offer was a set of three objections AAS had to the proposed name, board membership and publication policy.

These three points were met by the ARS counter-offer, according to the rocket society, which proposed calling the merged groups the American Rocket and Astronautical Society; accepting three AAS members to serve on the ARS board for three- two- and one-year terms respectively, and continuing to publish Progress in Astronautics, the AAS journal.

The AAS members against the merger feel the smaller society would lose its identity, and that there is still plenty of room among professional societies for one devoted exclusively to the space sciences. They also feel that American Rocket Society would be the big gainer with the word "astronautics" in its name.

Space Mice Offspring Unhurt by Radiation

Brooks AFB, Tex.—First offspring of mice that survived space flight, experiencing extremely high radiation exposure, and long-duration g forces and weightlessness, show no traces of harmful genetic effects, according to technicians here at the USAF School of Aviation Medicine who have been monitoring the project.

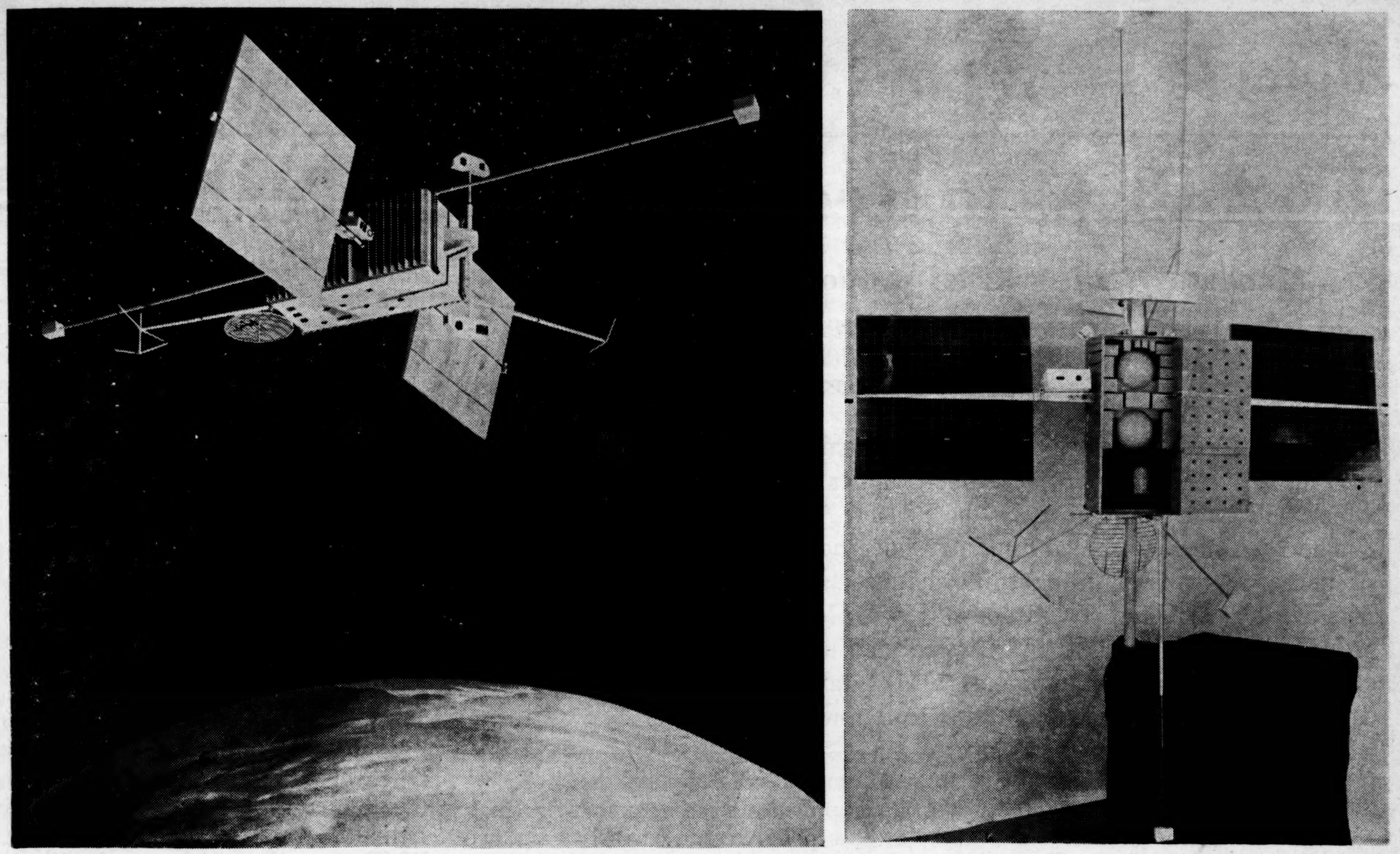
The three mice, Moe, Amy and Sally, were lofted 600-mi. high and traveled some 4,400 mi. downrange from Cape Canaveral to Ascension Island in a 16-lb. aluminum capsule inside the nose cone of a Convair Atlas missile on Oct. 13.

Flight duration from launch to splash was approximately 30 min.

During its trajectory the space experiment penetrated the lower Van Allen belt during the upward and downward phases of the flight and the mice were subjected to less than 1 Rad dosage of heavy primary particles, according to instrumentation. This is less than the dosage normally experienced by a human taking a chest X-ray.

Apparently as a result of this radiation exposure, the mice some three weeks after recovery developed some tufts and single traces of white hair. Following recovery the female mice were bred with Moe. Amy recently delivered five mouselings and the following day gave birth to a sixth, stillborn mouse. The five live mouselings show no genetic traces of their parent's space experience, according to Dr. Hans G. Klamann, chief of the Department of Space Medicine here. Actually, he states, even with a heavier dosage than was experienced by the parents, the possibility of genetic effects on offspring is unlikely—one in several million, he added.

The fact that there was a stillborn mouseling in the litter is considered insignificant here, since the initial litter of mice is generally very small and it is not unusual for from one to three of



Orbiting Geophysical Observatory Details

OGO satellite in orbit, with solar paddles flanking the 6 x 3-ft. spacecraft, is shown in artist's conception at left. Satellite will weigh 1,000 lb., with growth potential to 1,500 lb. including a 300 lb. piggyback experiment. Model of the orbiting geophysical observatory (OGO) at right shows standard components in light color, experiments in black. Space Technology Laboratories, Inc., recently won a $15 million contract (AW Dec. 26, p. 24) to build three of these modular packages.

the first litter in normal births to be stillborn.

Of particular interest to scientists was the fact that the mice trio experienced more than 20 min. of weightlessness during the flight—the longest such state for warm-blooded animals thus far in the U. S. space biology program. Instrumentation showed that the mice pulse rate went down to approximately the same level as during sleep, according to Dr. Klamann, indicating that the subjects were apparently quite comfortable during this portion of the experiment.

Their pulse rate went up some 60% over normal during launch, he noted, and this is attributed to noise and vibration rather than acceleration forces. During re-entry, the pulse rate again climbed to approximately 600 per min. compared with 300 per min. normal, but this is attributed to effects of aerodynamic noise.

The mice experienced from approximately 10g to more than 50g over a re-entry period of approximately 40 sec., Dr. Klamann reported. Although these are high and long-duration forces, he noted that mice are extremely capable of handling high g-loads and are considered to have tolerances roughly 10 times those of humans. Indications are that the trio of mice experienced very close to their upper margin of g-tolerance during the flight.

News Digest

Air Force canceled Avco-Everett Research Laboratory's $6 million contract to develop a re-entry vehicle drag brake last week, following budget and technical review.

Four U. S. helicopters—two Sikorsky S-58s and two Vertol 44s—have been delivered to Russia as a result of Soviet Premier Nikita Khrushchev's 1959 visit to the U. S. Presumably, the two S-58s and one of the Vertol 44s will be used as executive transportation for top Soviet officials. The other Vertol is in the standard airline version. The S-58 seats 12, the Vertol 19. Both companies trained Soviet pilots and mechanics and are prepared to furnish parts. Neither company anticipates further orders.

Ball Bros. Research Corp. contract for the structure for the orbiting solar observatory (OSO) is under negotiation with National Aeronautics and Space Administration. Delta-launched OSO payload is designated S-16 by NASA. Ball Bros. has been studying satellite-borne solar control for the system under a contract awarded a year ago.

Northwest Airlines was scheduled to resume partial DC-8 turbojet service last week, with supervisory personnel serving as flight engineers pending settlement of its 75-day-old strike of 28 International Assn. of Machinists flight engineers (AW Oct. 24, p. 41). First flight was to operate Seattle-Chicago-Miami.

First fixed-wing airframe installation of new 250-shp. Allison T63 turbine will be turboprop version on early model Beech L-23 (Model 50 Twin-Bonanza) to be made by the engine manufacturer on an airplane bailed to it by the U. S. Army.

Giuseppe M. Bellanca, 74, died last week in New York. He designed the Wright-Bellanca monoplane Columbia which in 1927 set an endurance record of 51 hr. 11 min. 25 sec. and was the first aircraft to fly the Atlantic with a passenger. He founded the Bellanca Aircraft Corp., which he sold in 1954.

Boris Cheranovski, Soviet aircraft designer, died Dec. 17, at the age of 64, according to Izvestia.

Explorer VIII direct measurement ionospheric satellite, launched Nov. 3, went silent Dec. 27 after sending weak and intermittent signals for several days. Mercury battery power supply had 2-3 months estimated lifetime.

AIR TRANSPORT

FAA Plans to Require DME on Transports

Mandatory rule will be proposed soon for airlines; first installation expected to be on jet aircraft.

By Philip J. Klass

Washington—Distance measuring equipment would become a mandatory navigation aid for transport type aircraft under a Civil Air Regulation revision which will soon be proposed by the Federal Aviation Agency.

The FAA move has been under consideration for some months, the value of such equipment was brought into sharp focus by the recent midair collision of a United Air Lines DC-8 and a TWA Constellation in the New York area (AW Dec. 26, p. 27). FAA is expected to propose that first installation of distance measuring equipment (DME) take place on jet aircraft, with equipping of piston-engine transports to follow.

The Air Transport Assn., which several years ago expressed the view that there was no operational requirement for DME and that its use should be on a voluntary basis, is not expected to contest the upcoming FAA action.

American, Pan American, Trans World and Continental Airlines are among the U.S. carriers which have ordered, and started to use, DME. United Air Lines, which has been evaluating the two available DME equipments, made by Collins Radio and International Telephone and Telegraph Corp., has decided to outfit its entire fleet, starting with its jets.

Airline support for the proposed FAA mandatory DME action results in part from growing indications that the recent midair collision may have stemmed from an error in navigation, possibly failure of one of the DC-8's two VOR omni-conversion units.

If the DC-8 pilot had only one operating VOR, it is theorized that he might have accidentally tuned to the Stroudsberg omnirange station, at a frequency of 114.7 mc., instead of the intended Solberg station operating at 114.2 mc., to fix his position relative to the Preston holding point, which is established by the intersection of the 120 deg. radial with the Victor 123 airway. The 120 deg. radial from the Stroudsberg station intersects Victor 123 near where the collision is believed to have occurred. If this error had occurred, the pilot would have thought he was approaching the Preston fix when in fact he was 10 mi. beyond this point. DC-8's VOR receiver and its tuning head, both recovered from the crash, may provide evidence to support or refute this theory.

In an aircraft equipped with DME, the pilot gets a direct reading of his position along the airway from the Vortac station whose radial he is flying. This provides a more precise fix than is now possible using radials from two VOR stations. Also, in the event of failure of one of the two VOR airborne receivers, the pilot would not have to alternately tune to different VOR stations while in a holding pattern.

The Robbinsville VOR which provides the Victor 123 airway service does not yet have a commissioned DME capability, although the equipment is installed. The United DC-8 therefore would not have gotten distance-along-the-airway information even if it had been equipped with an airborne DME. However, it could have fixed its distance from one of three nearby commissioned Vortac stations at Idlewild, Solberg or Stroudsberg.

Jet Clearances

New York—Federal Aviation Agency has abandoned its practice of clearing jet transports inbound to Idlewild Airport along the airways followed by a United DC-8 just before it collided with a TWA Constellation on Dec. 16.

Under the new preferential routing, eastbound jets reporting over the Allentown, Pa., VOR are cleared direct to the station at Robbinsville, N. J., then northeast along Victor Airway 123 to Preston.

FAA's former clearances cut the corner involved in flying down to Robbinsville by instructing pilots to follow Victor Airway 30, an east-west course line passing 8 naut. mi. south of Preston.

Preston's proximity to this airway led airline pilots to complain that the intersection was not a satisfactory holding fix for high-speed jet transports. At the semi-annual regional meeting of traffic controllers and other FAA officials on Oct. 26, pilots argued that jets, accelerating in the descent from cruise altitude along V-30, were forced to make a 116 deg. course change while only two or three minutes from the intersection at which they must hold.

The mandatory requirement for DME coupled with the recent accident is also expected to spur airline and FAA interest in pictorial cockpit displays. Airlines previously found it difficult to justify the expense of pictorial display installations unless, and until, FAA developed traffic control procedures to enable aircraft equipped with pictorial displays to benefit from their use.

There are several reasons why the FAA has not moved earlier to make DME mandatory. About the time that the former Civil Aeronautics Administration had installed several hundred DME ground stations, and airborne equipments were becoming available, the bitter conflict between civil DME and military Tacan broke out. When this was finally resolved with the decision to adopt a combination of VOR and Tacan (Vortac), FAA had to buy and install new ground station equipment, and new Tacan-compatible airborne DMEs had to be developed.

First airborne Tacan-compatible DME to be marketed was one produced by ITT, which had developed Tacan and built the original military airborne sets. American Airlines was the first to order and install the new equipment, but it subsequently had to pull them out of service because of reliability problems. These early troubles have now been cleared up, according to both FAA and ITT, and American is now reinstalling equipment in its jet fleet.

Collins Radio, the second DME supplier, has had prototype units under evaluation by six airlines, including American, Braniff, Delta, Pan American, TWA and United. The company expects to be in production by March, turning out 30 or more sets per month. Production at ITT is about 30 per month, but it could be accelerated.

FAA was reluctant to make DME mandatory until there were at least two suppliers of satisfactory airborne equipment and until there were sufficient ground stations commissioned. At present, FAA has approximately 250 Vortac stations commissioned.

The airlines in turn have been reluctant to invest in DME on a voluntary basis for the same reasons, plus several additional ones. The ITT equipment initially marketed did not meet the

FAA's distance measuring equipment technical standard order (TSO) requirement for rejection of spurious pulses. Both FAA and ATA held that unless this requirement were met, the equipment would not be usable if FAA should find it necessary to increase the number of Vortac stations and had to resort to channel splitting to do so.

The FAA granted ITT and its DME purchasers a two-year waiver on the TSO, with the understanding that the company would redesign the set to meet spurious pulse rejection requirements. This ITT has done, a spokesman told Aviation Week, and the design change will be introduced in the production line approximately after the 250th equipment. A Collins spokesman says its DME meets this spurious pulse rejection requirement and requires no waiver.

Initially, the airlines looked unfavorably on the use of subminiature tubes in the Collins DME but this view has softened as the result of reliability exhibited by these tubes in Collins prototype sets the airlines evaluated. The ITT equipment does not use subminiature tubes.

An ITT spokesman reports that his company has delivered approximately 150 DMEs to date and has purchase orders for another 150. These figures include about 60 for American Airlines, 80 for TWA, 17 for Pan American, and 80 sold to Convair for installation on its 880 jetliners. Collins reports orders for about 60 sets, all of them for general aviation and corporate aircraft.

The ITT distance measuring equipment sells for approximately $5,000, the Collins equipment for approximately $6,000.

Sabena Flights Normal Despite Belgian Strike

Brussels—Sabena Belgian World Airlines reported last week that its flights were operating without interruption despite the crippling general strike that paralyzed much of the surface transport facilities within the country.

In response to the strike order issued by the Socialist Party to protest planned economies by the Christian-Socialist (Catholic) government, an estimated 10% of Sabena's 8,000 employes walked off the job. Most, however, were manual laborers, and their absence did not affect normal operations. Airport buses and taxis were still running regularly between Brussels and the airport.

A Sabena spokesman said late last week that the strike should not have any major effect on the airline's operations so far as passengers and schedules are concerned unless it becomes prolonged and does serious damage to the Belgian economy in general.

Trunkline Profits Hit 11-yr. Low Because of Transition to Jets

Washington—Domestic trunkline industry net profit for 1960, estimated at approximately $4 million by the Air Transport Assn., reached the lowest level since 1949 as jet transition increased costs faster than record revenues.

This dismal profit picture, close to the $3.8 million profit forecast by Aviation Week (AW Nov. 21, p. 35), is in sharp contrast to the all-time high of $1.9 billion in gross revenues earned by the industry during the year. At 3.4%, it represents a low rate of return when compared with the 10.5% return on invested capital recently authorized by the Civil Aeronautics Board. The average rate has been 6.2% over the past five years.

During the year, gross expenses climbed 14% as a result of depreciation of new equipment, training and other introductory costs involved in the transition to jets. Profit margin on sales for the industry in 1960 was .2%, compared with 3.4% in 1959 and 3% in 1958.

ATA President Stuart G. Tipton reported the trunklines more than kept pace with competitive forms of transportation in 1960. He said: "The railroads estimate that they operated 3% less revenue passenger miles, the intercity buses stayed at 1959's level, while the domestic airlines turned in a 5.4% increase over last year."

More Passengers Carried

The 12 domestic trunklines carried 45.7 million passengers in 1960, compared with 44.5 million in 1959. Local service carriers handled 5.6 million during the year compared with 5.2 million the previous year, and helicopter airlines showed an increase from 366,000 to 504,000. International and overseas airlines climbed from 4.7 million to 5.3 million passengers, Alaskan carriers from 300,000 to 400,000 and intra-Hawaiian airlines from 800,000 to 900,000. ATA estimates are based on reported figures for three quarters, with the fourth quarter estimated.

According to the ATA estimate, close to half the total expenses of the domestic airline industry are attributable to wages and employe benefits. As of June 30, the industry was employing 168,457, a net increase of 3,573 over 1959. Annual payroll projection for 1960 was $1.1 billion, a $22.5 million increase over 1959. Average annual wage per employe was $6,567. Commerce Department studies show that average annual earnings for full-time employes in all industries were $4,576 in 1959.

U. S. domestic airlines had accepted delivery of 485 turbine-powered aircraft by last month. Of this total, 278 were turboprop transports and 207 were turbojet-powered. On order for delivery between 1961 and 1963 are 28 turboprop and 193 turbojet and turbofan transports. Total fleet for the domestic industry stood at 1,800 aircraft of all types at the year's end.

The ATA report found that 75.6% of all overseas travelers now travel by air. It noted that in 1950, 75% of all international air travelers flew on U. S. flag carriers but that by 1960, this figure had dwindled to 54.7%.

Ton-Mile Increases

In revenue ton-miles, intra-Hawaiian carriers—Aloha and Hawaiian—showed the largest increase during 1960. The two companies handled 18.4 million revenue ton-miles during the year, compared with 12.7 million in 1959. The three helicopter airlines topped the million mark for the first time with 1,065,000 revenue ton-miles against 856,000 in 1959. The trunkline ton-mile figure moved to 3.3 billion from 3.1 billion, and local service carriers climbed from 108 million to 122 million ton-miles.

Domestic trunklines earned estimated revenues of $44.5 million for carrying mail, including both priority and non-priority mail—first-class surface mail that moves on a space available basis. During the year, the Post Office Department expanded the volume of non-priority mail to 25,000 tons, representing income to the airlines of $4.8 million and savings to the Post Office of $134,000 over sending the same volume of mail by surface, according to ATA.

ATA also reported an estimated 9.4% gain over 1959 in the volume of air freight handled by the domestic scheduled airlines. The entire U.S. industry handled 704 million ton-miles of express and freight in 1960. Of this amount, the 12 trunklines accounted for 374 million ton-miles, international and overseas carriers flew 197 million ton-miles and all-cargo airlines flew 128 million.

Air express ton-miles were 4% above last year's volume. The industry flew an estimated 59.1 million revenue ton-miles of express in 1960, compared with 56.6 million during 1959.

Passenger revenues for the 12 domestic trunklines totaled $1.77 billion, compared with $1.63 billion last year. Express and freight revenues total $96 million compared with $86 million in

1959. Net operating income for the industry was only $19 million, down sharply from the $105.2 million figure last year.

American Airlines has attributed the poor industry showing to general economic developments during the year which the carrier said had the effect of slowing down the rate of growth of airline traffic. American forecast a moderate growth for domestic airlines in 1961 and said:

"General economic developments are likely to continue exerting a drag on airline traffic in the first half of the year. Traffic growth will be resumed in the second half if the expected upturn in general business activity materializes."

The airline believes that continued improvement in equipment and service, as in the past, will generate a more rapid growth rate for the airlines than for the economy as a whole. The carrier also feels traffic growth will be further stimulated by the increased speed and comfort of the new turbine equipment now being introduced by the airlines.

How lasting an effect the impact of the midair collision over New York (see p. 26) will have on traffic remains to be seen. However, highly publicized accidents tend to make deep dents in normal traffic growth over an extended period of time (AW Feb. 29, p. 38). For example, the 1956 midair collision over the Grand Canyon brought an immediate decline in traffic growth that slowed down airline business activity for close to three months.

Landis Urges White House Office To Oversee U.S. Transport Policy

By Robert H. Cook

Washington—White House coordination and close supervision of national transportation policy for the guidance of a streamlined Civil Aeronautics Board and other agencies was recommended last week to President-elect John F. Kennedy.

James M. Landis, former CAB chairman, made the recommendations in his special report on the regulatory agencies, prepared at Kennedy's request (AW Nov. 21, p. 37). He urges a reduction in the volume of judicial activity required of the CAB and delegation of greater power to the Board's staff.

Other Reports

Kennedy ordered the Landis report immediately after his election. Along with this report, he will have the results of a Budget Bureau study of CAB problems (AW Nov. 28, p. 38) and a critical report on the Board produced by the House Legislative Oversight Subcommittee staff to consider in mapping plans for changes in the government's approach to air transport policy and regulation.

Landis would establish a new White House executive office called the Office for the Oversight of Regulatory Agencies. Under this general overseer would come three suboffices for transportation, communications and power. This organization would coordinate national transport policy and see that the executive agencies under direct control of the President follow this policy. This policy also would provide guidance for CAB.

Each of the new offices would be required to submit annual reports both to the President and Congress. Landis said the President should ask Congress for blanket reorganization authority, subject only to veto by both the Senate and House, to get the changes under way. All recommendations for reorganization would be prepared by the new White House overseer's office.

Emphasizing the importance of the proposed office, Landis indicated its objectives effecting aviation would be:

- **Rationalization** of government traffic needs, including military transportation, to avoid competition with commercial airlines.
- **Reconsideration** of user charges for federal facilities.
- **Study of foreign** air carrier competition.
- **Modification of CAB's** powers in granting air carrier certificates, to require more emphasis on the airline's operating costs, quality of service and ability to grow, rather than "mere" customer support.
- **Steps to establish** the cost of service, as the principal factor in determining the reasonableness of transportation rates.

Internal Problems

Much of the CAB's workload and attendant delay in processing cases on file could be solved internally, Landis said, through a reorganization plan that would establish the chairman's authority over all administrative matters, including the preparation and review of budget estimates, disbursement of funds and appointment of all personnel, except those directly appointed by presidential order.

At the same time, the report said any reorganization plan should provide for a delegation of authority to panels of agency members or hearing examiners for the final determination of all adjudicatory matters, with a discretionary review by the full Board only on the request of one of the parties concerned.

Pointing out that its "inordinate" delay in handling route cases and "extraordinarily complex" proceedings are major criticisms of CAB, Landis charged that the Board permits too many issues, such as "political, economic, sociological, business and aeronautical" to become involved in hearings without any predetermined plan to limit a case to the basic issues involved. Much of this information could be determined beforehand by "less legalistic and reasonably scientific" methods, leaving the only "judicial" consideration by the Board the issue of which competing carrier should be selected for the route in question. If necessary, full CAB hearings could properly be held on staff-prepared studies alone as a means of shortening route proceedings, Landis said.

Merger applications should be handled in a similar manner, the report said, and they should be considered in relation to a planned transportation policy rather than as a result of financial problems of one airline involved or the desire of the second carrier to "pay a higher price for a certificate" than another airline.

Certificates 'Bartered'

"Unfortunately," Landis said, "the Board has hamstrung itself so as to prevent this approach by permitting certificates freely given to a carrier by the government to become a subject of barter in the market and thus be put on the auction block to be sold to the highest bidder for a price which the public is eventually bound to pay."

Accusing the airline industry of "lobbying in the worst sense," Landis said the CAB has been "bedeviled" by "ex parte" presentations and the "acceptance of unusual hospitalities" for many years. He termed this problem particularly acute at the Board because of the President's power over international routes, noting that the only "cure" for this situation is presidential self restraint "which has been lacking in the last two administrations."

A lack of advance planning by CAB also was criticized by Landis, who contended this could best be overcome through his recommendations to reduce the Board members' workload by permitting delegation of more authority to hearing examiners or bureau heads on such matters as foreign air carrier permits, approval of air carrier agreements and interlocking relationships.

As a further time-saver, Landis recommended that the Board as a body should not participate in negotiations for international routes but should allow one member with a small staff to handle the task along with representatives of the State Department.

Landis also raised the question of CAB's interpretation of "public interest," which he contends too often has become a matter of "private interest" as a direct result of its need to maintain a close contact with the airline industry.

As an example, he cited the Board's "innate reaction" in approving the principle of subsidy payments to local service carriers while denying them to nonscheduled and all-cargo carriers.

Cargo Development

Pointing out the national interest in the development of air cargo services, Landis said the "tendency toward industry orientation" could largely be averted through the appointment of a public counsel "whose function is in almost direct relationship to his capacity to irritate agency members." Such a counsel should have the right to request an agency review of any hearing examiner's decisions, but would not be granted this right in cases already officially decided.

A "prime key" toward improving any administrative process is the necessity of attracting qualified personnel, Landis said.

The challenge of the job is the major attraction instead of financial reward, he said, although the chairman of the CAB, and those of other agencies, should be granted a moderate entertainment allowance plus a more liberal retirement plan. Landis also favors increasing the Board chairman's $500 annual pay differential above the other members' salary, since the extra sum is too small to be any compensation for the extra work involved and also is too small to enhance his prestige.

Ten-Year Terms

Ten-year terms for Board members were suggested by Landis as a means of ensuring that members gain more knowledge in their positions, free them from worry over being reappointed every six years, and making sure they would not be prone to use the appointment as a "stepping stone" to further political ambitions.

In other sections of his report, Landis further criticized Civil Aeronautics Board's lack of past planning to cushion the impact of jet aircraft on the airline industry's future.

"The impact of the jet plane, substantially tripling the capacity of propeller-driven aircraft on our domestic and international route structures," he said, "has received no serious consideration despite the obvious threat that the advent of the jet poses for the position of many of our intermediate trunk carriers. Instead of forward route planning, the CAB now finds itself faced with potential mergers that under the pressure of financial exigency may force changes in route patterns and route structures far different from those that might otherwise have been deemed desirable. With planes with a Mach 2 speed already on the drawing boards, planning far beyond the conventional jet is necessary. Re-evaluation of our theories of international air rights and routes should similarly now be in process."

Landis added that the value of aircraft as cargo carriers also has raised the question of whether it might be more in the public interest to spend the subsidy now going to local service passenger services on all-cargo operations.

In its comments on the CAB, the House oversight subcommittee said the Board has concentrated too much on the airline industry's economic problems and not enough on the promotion of air safety. The subcommittee staff recommended a $10,000 fine or five years imprisonment or both for any airline official found negligent in an air accident.

Shortening Procedures

To shorten the Board's lengthy economic proceedings, the staff also urged that airlines not be permitted to charge more than 25% of their costs in these proceedings for subsidy, mail pay or tax purposes.

"If the cost of these unduly protracted economic proceedings had to be borne by the air carriers involved, there is no doubt that they would be speedily curtailed in the interest of the airlines' own economy," the report said.

Local Airlines to Get New Subsidy Formula

Washington — Civil Aeronautics Board expects to implement a new sliding scale formula for subsidy payment to local service airlines by the end of this month.

Pending formal adoption of the new payment plan, which applies a uniform system of payment for all carriers, CAB has placed all 13 local service airlines on open mail rates.

Developed after nearly two years of discussion between the Board and the carriers (AW July 25, p. 36), the new plan will set monthly subsidy payments on a sliding scale formula for all carriers.

This differs from the present practice of determining the payments on an individual airline basis, based on a carrier's gap between operating revenues and operating expenses, plus a fair rate of return.

In practice, the new class mail rate is tailored to the carriers' daily volume of flight service, with a maximum subsidy rate of $3.05 per available seat mile permitted on the basis of 300 revenue plane miles daily per station. Payment rates decreases as the volume of service increases, with a CAB-imposed subsidy limit of 600 revenue plane miles per station, providing $1.90 of subsidy per available seat mile.

In addition, the plan contains a profit-sharing feature requiring that varying percentages of profits earned in excess of the 12.75% rate of return fixed for the local service industry be returned to the government.

Scandinavians May Offset SAS Losses

Stockholm—Danish, Norwegian and Swedish governments are considering proposals to help Scandinavian Airlines System offset an estimated $4 million deficit incurred in 1960 plus additional losses expected over the next few years.

Losses, actual and anticipated, are attributed primarily to jet equipment purchases and the subsequent rise in maintenance costs. One airline official said last week that the over-all number of passengers carried in 1960 showed a 16% increase over 1959, "but equipment investment has been too heavy."

Ministers of communications and for finance met here recently with SAS officials led by President Ake Rusck to discuss ways of providing the airline with up to $30 million to help it expand its working capital, now quoted at approximately $31.5 million, and pay its equipment costs over the next few years. In the jet field SAS is now operating Douglas DC-8s and Sud Caravelles and plans to introduce the Convair 990 on its Middle and Far Eastern routes next summer.

SAS Over Russia

Copenhagen — Scandinavian Airlines System last week gained Soviet permission to send a Douglas DC-6B on a ferry flight from Copenhagen to the Far East across the breadth of Russia.

The flight marked the first time an SAS aircraft has been permitted to fly beyond Moscow, and permission apparently was granted on a "one-shot" basis, although the airline has often sought permission to fly directly across Russia on its passenger flights to the Far East. Stops within Russia were made at Moscow and Tashkent.

The DC-6B was flown to Bangkok to replace a similar aircraft on lease to Thai Airways scheduled to return to Copenhagen for its major overhaul period. The returning DC-6B flew over the normal route via Rome and the Middle East.

ROYAL AIR MAROC

ROYAL Air Maroc Caravelle prepares for loading on ramp at Toulouse, having stopped there on Casablanca-Paris flight.

Air Maroc Bases Jet Service on One Plane

By Robert E. Farrell

Casablanca, Morocco—Rigidly-timed maintenance system plus aircraft reliability is permitting Royal Air Maroc, Morocco's state-controlled air carrier, to offer round trip jet service six days a week between Casablanca and Paris with a single Caravelle.

Scheduling has been met without a single flight cancellation since service began last May 20. Only delay, amounting to one hour, was due to late arrival of Caravelle spare part ordered from Paris. Company's single Caravelle will continue to be flown on tight scheduling until next Spring when the carrier's second Caravelle III will be delivered and put into service.

By Dec. 1, Royal Air Maroc's single Caravelle had logged 1,150 hr. without a serious mechanical problem. Jean DeLuc, the carrier's technical director, told Aviation Week introduction of the Caravelle didn't give him any more trouble than initial handling of the company's four L-749 Constellations.

DeLuc says that seven man-hours of maintenance are needed for each Caravelle flight hour. This is one hour more of maintenance than the company has established for a single Constellation flight hour. Royal Air Maroc spends three man-hours for each DC-3 flight hour.

Carrier's Fleet

Company has two DC-3s, four L-749 Constellations and the single Caravelle. A second Caravelle III is the only aircraft on order at present.

To keep its Caravelle on a six-day round trip basis, the company laid down the following operation and maintenance scheduling:

Based at its Casablanca headquarters, Royal Air Maroc's Caravelle begins its workweek on Wednesday. Flight 512 leaves Casablanca at 3:10 p.m., stops at Rabat, Morocco's capital, and then goes nonstop to Paris. The Caravelle returns nonstop to Casablanca in 2 hr., 45 min.—the same evening after laying over an hour and a half in Paris.

Same basic flight pattern is repeated during the next six days. On the Casablanca-Paris run, only one nonstop flight is made weekly. On the Paris-Casablanca weekly run, two nonstop flights are made. On other days, stops are made at Rabat, or Bordeaux, or Toulouse. Also, on Thursday and Sunday, the Casablanca-Paris flight is extended to Frankfurt, returning the same day. In every case, the company's Caravelle leaves Casablanca in the morning and is back in the hangar that night.

Six consecutive days of Caravelle flying—averaging six hours daily or 36 flight hours weekly—ends when it lands at 7:30 p.m. Monday night at Casablanca. Company's maintenance section then has a day and a half—until Wednesday at 3:10 p.m.—to prepare the aircraft for another six days of work. This is usually enough time to handle routine weekly inspection chores. Real maintenance test comes about every fifth week when the aircraft's 200-hr. inspection falls due. Royal Air Maroc handles all 200 hr. inspections. When 2,000 hr. Caravelle inspection comes—roughly once yearly—this work will be done by Air France in Paris.

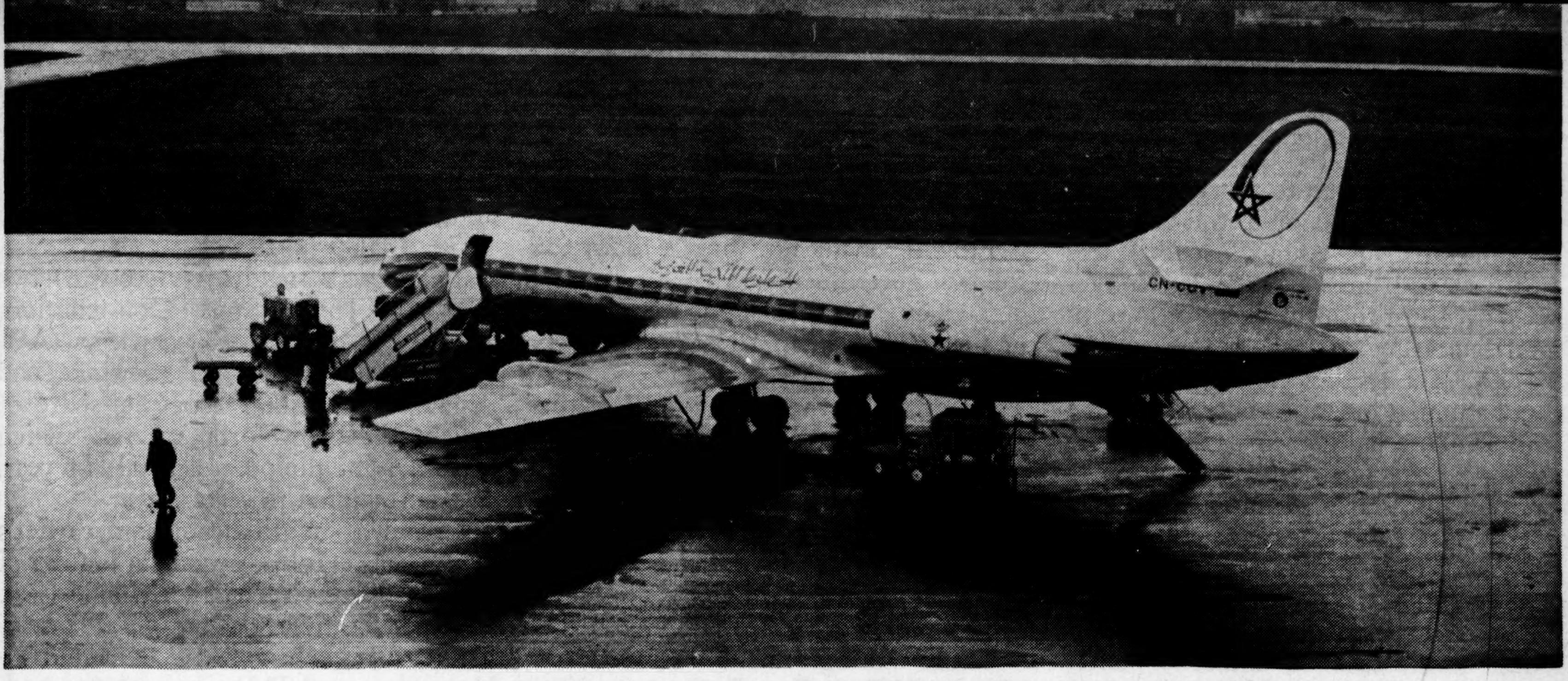
Maintenance Routine

Shortly after the company's Caravelle lands at Casablanca on Monday night for a 200-hr. inspection, a special 'preparation crew' immediately prepares the aircraft for the type of inspection required. This work takes from 3-5 hr. Actual maintenance work gets under way Tuesday morning and continues 10 hr. through that day. Work is then picked up again Wednesday morning at 7 a.m. and is programed to be completed by noon.

The aircraft is then rolled out on the apron for engine runup and preparation for the takeoff schedule.

To date the company has kept to this schedule through five 200 hr. inspections. Some inspections required time-consuming labor, such as complete dis-

ONE of the carrier's two DC-3s is shown at Casablanca preparing for takeoff to Agadir, Morocco. Constellation tail in background is Royal Air Maroc flight to Algiers.



CARAVELLE is shown loading passengers at Casablanca for Toulouse-Paris flight. It will return the same night.

mantling of cabin configuration. At times, minor items of a non-safety nature are left over to the next week. Decision to button up the aircraft is made usually on Wednesday morning. Whole 200-hr. inspection, entailing 600 hr. of work, is completed within 18 hr. by 35 mechanics.

Company officials say that reliability of the Caravelle airframe and Rolls-Royce turbojets have made their operation possible. The aircraft's two Rolls-Royce Avon turbojets recently were removed, as required, at 1,100 hr. Overhaul is being done at Rolls-Royce in England. Engines were in fine running condition when removed, according to DeLuc. He claims time between overhauls could go to 2,000 hr. on the Caravelle Avons without risks. Requirement has recently been raised to 1,200 hr.

Royal Air Maroc has five Avon turbojets for its single Caravelle and plans to have seven—four operating and three in stock—for its two-Caravelle fleet.

Officials of the carrier appear to be well satisfied with their single Caravelle on the commercial as well as the technical side. Caravelle load factor of 72% is even somewhat higher than the carrier projected. System-wide load factor runs to about 60%, with a load factor of 65% on international runs.

Company operates its Caravelle with 20 first class seats (two and two) and 55 tourist (two and three). Flight crew consists of two pilots and a flight engineer. Copilot also handles the radio chores. Caravelle pilots are French. In fact, all the carrier's flight and cabin personnel—except for 12 Moroccan stewards—are European, mostly French. The company employs 26 pilots, 17 flight engineers, 12 radio engineers and 23 hostesses.

Royal Air Maroc currently is operating a five-class fare structure:

- **First class.** Charged only on Caravelle flights and on two Constellation flights to Marseilles and Nice.
- **Tourist class.** Charged on Caravelle flights only. Both first and tourist Caravelle fares are aligned on Air France Caravelle service to Casablanca.
- **Economy class.** Charged on most of the company's Constellations, all of which are configured for 64 seats.
- **Economy class, night.** Charged on Constellation night flights to France.
- **"B" class.** Charged on company's two DC-3s operating within Morocco and to Algerian points.

Fare Structure

This elaborate fare structure meets its special requirements, the company feels. Thus it isn't anxious to join IATA although it follows IATA rules as closely as possible on its international runs. These break down:

- **Casablanca-Paris-Frankfurt.** This main trunk line was extended to Frankfurt last May with delivery of carrier's first Caravelle. En route stops are Rabat, Bordeaux and Toulouse. Both Caravelle and Constellation equipment are used.
- **Casablanca-Geneva.** Weekly Constellation flight with stops at Bordeaux and Rabat.
- **Casablanca-Nice-Lyon.** En route stops are Rabat, Oujda, Morocco, and Marseilles. Not all these Constellation flights are through services, some terminating in Marseilles and Nice. A second Caravelle will go on this route next spring.
- **Morocco-Algeria.** Constellation and DC-3 flights linking Moroccan cities with the cities of Oran and Algiers.
- **Casablanca-Dakar.** Weekly nonstop Constellation service.
- **Morocco-Spain.** Twice-weekly Constellation flights from Casablanca to Madrid. In addition to this main route, the company also operates short flights linking Moroccan Mediterranean cities like Tangier with Gibraltar and Malaga, Spain.

All of Royal Air Maroc's routes to France, as well as its southern run to Dakar, are operated under a pool agreement with Air France. Carrier also pools with the Spanish lines, Iberia and Aviaco, on routes to Spain, and with Gibraltar Airways on its Tangier-Gibraltar run.

With exception of the Frankfurt addition last May, Royal Air Maroc has been operating its present international network for several years. Its main effort to date has been to link Morocco with France. About 80% of the line's traffic is French, 15% foreign and only 5% Moroccan.

Ironically, the carrier's business has improved since the country's independence in 1957. Many Frenchmen while returning to France, nonetheless continue to supervise business interests in the former French protectorate. Traffic is also seasonal, with summer vacation periods providing highest flight frequencies between Morocco and France.

Future route plans of Royal Air Maroc may reduce present traffic dependence on the French-Moroccan link. While service to Milan is the only new route definitely in the works for next year, the carrier is also studying routes to England, Belgium and Scandinavia. It is likely that the company will order a third Caravelle if it decides to open these routes.

Royal Air Maroc carried 134,161 passengers in 1959 and flew 15,500 commercial hours. This year company will have hauled about 150,000 passengers, of which 20% was by Caravelle since last May. Carrier's traffic has been increasing at an annual rate of 2-5% and company officials expect this rate to continue in the immediate future.

Royal Air Maroc traditionally has yielded profits for its owners. For the year ending June 30, company's profit was $1,020,000. Carrier officials expect the current year, ending next June, will turn in a higher profit since this will be the first full year of Caravelle operation.

Only drain on the carrier's earning

capacity is its domestic service. None of the nine domestic points served make money. Yet as the national carrier, Royal Air Maroc has to provide internal air service. For example, the airline is planning to rent several Beechcraft 18s and operate them on scheduled domestic service just to meet needs of government officials to get about the country quickly. Its DC-3s are too large for this particular job since potential traffic amounts to a half-dozen passengers per flight.

Company is also planning to replace its DC-3s with Max Holste Super-Broussard twin turboprops within the next several years. With equipment of this sort, plus increased effort to develop tourist traffic to such domestic points as Fez, Tangier and Marrakech, carrier officials hope to produce profit from the domestic network.

Royal Air Maroc, before the country's 1957 independence date, was a private company known as Cie., Cherifienne des Transports Aeriens. This company earlier had been formed as a result of a merger between two private Moroccan carriers, Air Atlas and Air Maroc. After independence, the Moroccan government took a majority interest in Royal Air Maroc.

Present ownership breaks down as follows: government, 55%; Air France, 30%; Cie., Air Transport, a subsidiary of the French Line, 10%; and Aviaco, Spanish carrier, 5%.

Majority of the board of directors are representatives of Moroccan government. Of the company's 615 employes, about 80% are nationals. Moroccans hold several top posts although daily operation is in the hands of Managing Director Andre Faurous, formerly with Air France.

Under an agreement between the Moroccan and French governments, French personnel—who still largely run the airline—are guaranteed future jobs with Air France when their present posts with Royal Air Maroc are taken over by nationals. Without such an agreement, few French nationals would have been willing to stay on.

Jets Help Lufthansa Register 1960 Gains in All Air Traffic Categories

Cologne—Lufthansa West German Airlines' preliminary 1960 results show increases in all categories of air traffic which should enable it to reduce by about $6 million the $10-million loss it sustained in 1959.

Lufthansa spokesmen say this recovery was due primarily to the improvement in its share of the North Atlantic traffic since it introduced its first Boeing 707-420 jet services on this route last spring (AW Sept. 26, p. 45.)

The airline passed the million-passenger mark for the first time during 1960 with an estimated 1.2 million. Freight carried totaled 15,290 tons, mail 4,345 tons.

Load factor was boosted from 54% in 1959 to 60% and total payload climbed 3% to 57%. Over-all ton-mile capacity rose from 135.7 million in 1959 to 207.3 million. On the other hand, total expenditures increased by only 35%, not including the cost of the airline's pilot training school at Bremen and between $3,370,000 and $5 million spent for "special commitments" expected to be written off by the sale of surplus piston-engine aircraft.

Against this, Lufthansa's estimates for 1960 show an over-all increase in revenue of 43% and a reduction in operating costs of approximately 12%. Its expectations seem justified that it will be able to cover about 94% of its total expenditure with 1960 revenue.

In 1959, the company lost on average of 5.8 cents per ton-mile flown. This figure has now been reduced to about half—between 2.6 and 2.9 cents per ton-mile.

With the introduction of 707s on the North Atlantic last spring, capacity was increased between April and October to 101,028 seats, of which 75,287 were sold for an equivalent load factor of 74.5%. During the peak summer travel period, Lufthansa's share of North Atlantic traffic with its new jet services climbed from 5 to 5.6%. Daily utilization rate of 10½ hr. was established for each 707-420.

Traffic Increase

During the same travel period, traffic on the Chicago route jumped to 71% and, on the San Francisco schedule inaugurated last May, the airline achieved a 60% payload.

In July, 1959, an average of 52 passengers were carried on each flight across the Atlantic as compared with 116 in July, 1960. Load factor on the South American services was boosted from 54% in the summer of 1959 to 70% this summer and from 52 to 61% on the airline's European routes; from 36 to 60% on its national network.

In 1960, Lufthansa for the first time made a large-scale effort to improve its charter business and increased capacity available on the North Atlantic network by 50% over the 1958 figure, the number of flights by 63% and revenue by 84%.

Deutsche Flugdienst GmbH., an associated company of Lufthansa, is in charge of the domestic charter flight business. Here, results are showing a downward trend. A total of 75,000 tourists were carried on these flights in 1958, 40,000 in 1959.

Lufthansa's freight services with two Lockheed 1649A Super Constellations converted into cargo carriers (AW Aug. 1, p. 49) also are showing good results. The airline hopes its share of freight traffic to North America, which was 4.5% of the over-all total last year, will be doubled this year.

Included in the German carrier's 1961 plans is introduction on Jan. 23 of 707s on its services to the Middle East. At the same time, the present 707 service to Bangkok will be extended to Hong Kong and Tokyo.

The Lufthansa Super Constellation presently serving South America will be phased out and replaced by Boeing jet transports in April, under present plans. Introduction of new routes to the U. S. Midwest and South Africa, polar flights to the Far East, additional services to India and to more Middle Eastern countries are goals on which the airline is concentrating.

The company foresees good prospects for gaining its share of future traffic by establishing itself in emerging countries in such areas as North and West Africa. It also plans to strengthen its European network during the coming year and to introduce direct jet services to North America from Hamburg, Cologne and Munich next spring. All jet service is now flown from Frankfurt.

Lufthansa officials say realization of these plans depends largely upon results achieved by International Air Transport Assn. in its negotiation on international tariff rates. Lufthansa is not in favor of increasing tourist fares but says it is ready to discuss reasonable increases in the first class rates. The airline also would agree to the establishment of lower special tariffs if they refer only to tourist traffic.

Lufthansa is concerned over the tariff situation on South Atlantic routes. The situation improved slightly when rates laid down by IATA were largely adopted but could become critical again through the introduction of the grand cabotage agreement between Brazil and Portugal, which may result in a tariff reduction equivalent to 54.3%.

The West German airline also is unhappy over a pending new cabotage agreement still being negotiated with Scandinavian Airlines System. Discussions at the government level were resumed last December and have broken down repeatedly since that time. The last meeting between the two parties ended in a complete deadlock a few weeks ago. Lufthansa claims that SAS wants preferential treatment within Germany which, it says, it cannot give.

Paperwork Delays TWA 880 Introduction

By David H. Hoffman

New York—Trans World Airlines began the complex process of accepting Convair 880s last week in an effort to inaugurate service by the middle of this month. But chances appeared slim that any of the new jets would be flying passengers on Jan. 10, date of the carrier's next system-wide schedule change.

Four and perhaps five of the 20 880s TWA will purchase are ready to enter the carrier's acceptance flight test program at the Convair plant in San Diego. TWA pilots there were ready to start checking the aircraft immediately after the carrier's $265 million refinancing program had been closed.

Closing of the financing program took place simultaneously in three cities: Wilmington, Del., TWA's corporate headquarters; Oklahoma City, where detailed CAB aircraft records are on file, and New York.

TWA's board of directors is scheduled to meet Jan. 5, but no action is expected then on naming of a new president. Membership of the board will not necessarily be revised, but if there are changes the most probable time will be at the annual meeting in April.

Even though this closing was completed last week, TWA officials report that several extra days per aircraft will be consumed by flight testing and minor pre-service modifications. In addition, detailed schedules listing city pairs and projected block-to-block times must be filed with the Civil Aeronautics Board at least 10 days prior to the inauguration of 880 service.

Filing of these schedules, as of late last week, had not taken place.

But TWA did ask CAB last week to approve Ernest R. Breech, former chairman of the Ford Motor Co., and Irving S. Olds, former chairman of United States Steel Corp., as two of the three trustees who will vote 78% of the airline's stock owned by Hughes Tool Co. They will represent the lenders. Earlier, Raymond M. Holliday, vice president of Hughes Tool, had been named Howard Hughes' representative on the trusteeship.

Of the $165 million to be furnished by outside lenders, $72.2 million will come from a nine-bank group headed by Irving Trust Co. and $92.8 million from Equitable Life Assurance Society and Metropolitan Life Insurance Co. The banks' share of the package will be in TWA 6% equipment mortgage serial notes maturing through Dec. 31, 1964. Money loaned by the insurance companies will be in TWA 6½% equipment mortgage notes due Dec. 31, 1972.

The trusteeship arrangement, which was demanded by the lending group, will last for 10 years unless Hughes exercises his option to prepay the outstanding debt. Attached to this option, however, are several important conditions which combine to indicate the trusteeship will not be dissolved at an early date. Foremost among them:

- **Hughes must pay off** the banks and the insurance companies concurrently if he wishes to regain control of TWA. The banks' terms are relatively lenient in that prepayment of principal and accrued interest can be made any time after Dec. 31, 1961, without penalty.
- **To prepay the insurance companies,** Hughes would have to pay a 22% premium on outstanding principal prior to Mar. 31, 1962. For every quarter thereafter, this premium drops .5%.

A major cost item attributable to delays in the refinancing program lies in the area of crew training. Many TWA pilots have been through Convair 880 training and related refresher courses three times in order to establish and maintain proficiency in the aircraft. First classes beginning last June.

Initial checkout, including ground school courses and jet simulator training, for a TWA 880 captain consumes about three weeks. While in training at the carrier's Kansas City, Mo., home base, captains and copilots continue to earn their full salaries based upon flying 85 hr. per month, half day and half night, on scheduled trips.

Once pilots are 880 qualified, TWA's practice has been to hold them in reserve pending delivery of the first line aircraft, expected "almost momentarily" since June. As a result, many captains and copilots who earned 880 ratings last July have had five months of inactivity during which they were also paid full salaries.

Despite the plenitude of TWA pilots holding 880 ratings, the carrier faces a severe scheduling problem when the first aircraft are ready for service. Reason for this is the Federal Aviation Agency requirement that a captain, before flying as an aircraft commander, have at least 30 hr. of 880 time logged "on the line." According to one TWA 880 pilot, who returned from his third Kansas City training trip last month, there are only four or five such captains available within the entire airline.

Moreover, FAA's new training program, which governs how airline pilots will qualify and maintain their currency on transports, took effect yesterday and may well boost the cost of TWA's 880 phase-in even higher. Under the new rules, a pilot holding an Airline Transport Rating must do more than merely land a particular aircraft three times within the 90 days preceding a flight in order to keep current; he must, in many instances, demonstrate his proficiency during a comprehensive flight check with an FAA representative.

Although the program is not retroactive, TWA pilots who lack three 880 landings within the three months prior to their first scheduled flights, probably will need new "check rides" before assuming the control of jets carrying passengers.

Howard Hughes Sued by Attorney

Los Angeles—Complaint has been filed in the Los Angeles county court against Howard Hughes by Los Angeles Attorney James J. Arditto who alleges that Hughes owes him $1,094,250 for legal fees plus $12,237.25 in expenses for services.

Named along with Hughes in the action which was filed Dec. 23 by attorney Harold Rhoden of the Los Angeles law firm of Crowley and Rhoden, are the Hughes Tool Co., Hughes Aircraft, Howard Hughes Medical Institute, of Miami.

Rhoden told Aviation Week that Hughes is being named in the suit personally because Arditto alleges Hughes still directly controls the Medical Institute, Hughes Aircraft and Hughes Tool Co., and that the latter corporation is insolvent. Hughes controls Hughes Aircraft, the complaint alleges, because the Hughes Medical Institute is sole stockholder in the aircraft company and Howard Hughes is sole trustee of the nonprofit medical institute.

The complaint further states: "At all times herein mentioned, Howard Hughes used and still uses, the corporation (Hughes Tool Co.) as a conduit for the transaction of his personal affairs and private business interests and as an alter-ego instrumentality for the accomplishment of his personal financial interests under a corporate guise and facade, and said Howard Hughes used and still uses, the funds of said corporation to pay his personal expenses including, among others, personal legal fees, medical expenses, personal entertainment and living expenses, and said Howard Hughes uses and still uses the funds of said corporation to sustain personal hobbies."

Hughes Aircraft Co. spokesman termed the allegations in the complaint "ridiculous," especially the charge that Hughes Tool Co. is insolvent.

AIRLINE OBSERVER

▶ British reports of future flight tests of an "ogee" wing on the Fairey FD.2 high-speed research aircraft have set off speculation that industry is trying to circumvent government limitations restricting supersonic transport work only to wind-tunnel testing. Ogee wing, currently favored by British Aircraft Corp. as the basis of design studies for a supersonic airliner configuration, gets its name from the S-shaped leading-edge of the wing.

▶ Airline hull liability insurance rates will not necessarily be forced upward by the TWA-United collision, but underwriters may feel the ensuing losses justify the high rates that accompanied the jet transition and resist any future requests for reduction. However, if investigation leads underwriters to believe there is a fundamental problem at the root of the two crashes—such as a deterioration of the adequacy of the New York traffic control system to handle jets—a move to increase rates is likely. Otherwise, underwriters may feel the collision was one of the eventualities allowed for in fixing rates. No single year's experience is used in setting insurance fees, so the collision alone would not normally be a governing factor in a rate change.

▶ Sabena Belgian World Airlines has expressed interest in leasing several Sikorsky S-61Ls, a twin-turboshaft helicopter capable of carrying 28 passengers (AW Dec. 19, p. 42). Cutbacks in long-haul passenger traffic resulting from hostilities in the Congo have so strained the carrier's finances that outright purchase of the $650,000 helicopter is not considered feasible. Sikorsky takes a dim view of leasing the S-61L, but hasn't ruled out such a program as a future possibility.

▶ Eastern Air Lines will spend about $33 million this year on new ground facilities. Some $18 million is slated for new jet hangar, turbine engine overhaul plant and improvement of present facilities at Miami. Maintenance facilities, including new hangars at Boston, Atlanta and Norfolk, will account for $13 million. Balance will cover costs of airport terminal improvements throughout system and new or refurbished ticket and reservations offices in 20 cities.

▶ Special Russian investigating teams of Komsomol (Young Communist League) activists have found that Aeroflot's advertising messages aren't getting across to the public. Results of a poll taken by the group showed that many Moscow citizens had only a vague idea of the services offered by the Soviet airline. Investigation disclosed that people at one Moscow station were taking the train to Irkutsk in central Siberia because they were unaware of air transportation's time advantage. Most train passengers had no idea of airline fares or the amount of baggage that can be carried free by air. Others thought planes seldom flew during the late fall and winter, and many were unaware that buses operate regularly to all Moscow airports.

▶ International Air Transport Assn. forecasts that a total of 118 million passengers will be carried by the world's domestic and international airlines in 1961. International Civil Aviation Organization has estimated that the world's airlines carried 108 million passengers in 1960, a 10% increase over the 98 million handled in 1959.

▶ Federal Aviation Agency has removed the 7,600 hr. safe life limit on the Fairchild F-27's center wing section (AW Oct. 24, p. 42), thus saving local service carriers operating the twin turboprop transport about $50,000 per wing per aircraft in their fleets. Declared a "fail safe" instead of a "safe life" component by FAA, the center wing sections no longer need be scrapped at the 7,600 hr. mark, but can be used indefinitely if periodic inspections are performed.

▶ Delta Air Lines has scrapped sectionalized overhaul plans for the General Electric CJ-805-3 turbojets powering its Convair 880 fleet. Delta feels that authorized time between overhauls of the CJ-805-3 can be accelerated so rapidly under Federal Aviation Agency's failure rate formula (AW May 9, p. 38), that sectionalized overhaul, at TBO levels near 1,000 hr., would impose an economic hardship. The airline may re-examine the sectionalized overhaul concept proposed by GE when usage has determined the safe life limit of certain of the engine's components.

SHORTLINES

▶ **Alaska Airlines** is adopting a family fare plan, allowing members of a family over 12 years of age to travel at two-thirds of the regular fare when one member pays the full fare. The plan was scheduled to go into effect Jan. 1, and continue until Apr. 30, subject to Civil Aeronautics Board approval.

▶ **Continental Airlines** has asked Civil Aeronautics Board permission to cut air freight rates up to 37% on cargo moving during the daylight hours from Los Angeles to Chicago in order to encourage shippers to use the daytime turbojet flights between the two cities. Shippers would have to get shipments to Continental's facilities or its cartage agent in Los Angeles between 2 a.m. and noon. Cargo would be scheduled on any of the airline's four turbojet flights to Chicago, which have a total of 80,000 lb. capacity.

▶ **Eastern Air Lines** will add Sarasota/Bradenton, Fla., to its system Jan. 15 as a result of the recent Civil Aeronautics Board decision in the Sarasota/Bradenton Service Investigation. Eastern will offer seven daily flights at the dual city airport.

▶ **Northeast Airlines'** deadline for starting service at Baltimore's Friendship International Airport, ordered by the Civil Aeronautics Board in the Washington-Baltimore Adequacy of Service Investigation, has been extended to Feb. 28. The Board originally stayed the effective date of its order until Jan. 16. Northeast asked for a further stay to get its Convair 880 turbojets on the route to Florida from Baltimore and obtain station facilities at Friendship International Airport.

▶ **North Central Airlines** carried more than one million passengers in 1960, becoming the first local service airline to reach the million-passenger mark. Based in Minneapolis-St. Paul, North Central last month increased its system by about 30% with the addition of 15 new Michigan cities. It serves 10 midwestern states with a present route mileage of about 6,900.

▶ **Real Airlines of Brazil** has been awarded traffic rights from Rio de Janeiro to New York via Lima, Peru, by the Brazilian Ministry of Aeronautics. The airline currently serves the U. S. at Miami and Los Angeles. Real plans to inaugurate turbojet service on all its international routes early in the summer using Convair 990 turbojet transports scheduled for delivery in late spring.

Airline Income & Expenses—October, 1960

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	35,017,020	627,043	345,648	2,341,188	....	38,980,950	35,179,871	3,801,079
Braniff	6,165,672	182,241	52,402	134,250	118,167	6,742,701	6,162,737	461,371
Capital	8,535,751	200,328	144,147	177,660	56,596	9,244,912	9,099,182	145,730[3]
Continental	5,008,000	94,000	47,000	135,000	21,000	5,435,000	4,719,000	430,000
Delta	20,457,000	189,000	115,000	347,000	87,000[2]	11,364,000	10,350,000	789,000
Eastern	19,810,820	502,471	1,157,100[4]	....	1,982	21,610,473	22,174,024	−571,323
National	3,987,936	95,040	31,946	190,293	223,517	4,686,614	5,542,878	−1,007,273
Northeast	2,825,188	48,785	26,078	73,078	....	3,042,603	3,483,421	−440,818[3]
Northwest	6,085,021	229,933	612,043[4]	....	31,306	7,003,384	7,649,822	−635,619
Trans World	22,363,907	469,914	1,451,185[4]	....	144,581	24,692,640	23,500,140	1,192,499
United	31,215,323	1,100,588	2,397,074[4]	....	351,189	35,043,933	31,359,540	3,803,632
Western	4,721,088	111,227	208,730[4]	....	85,203	5,146,539	4,672,289	413,531
INTERNATIONAL								
American	338,092	9,075	1,381	67,892	....	439,864	691,869	−252,005
Braniff	838,654	25,001	....	48,875	....	970,734	977,081	−24,347
Caribbean Atlantic	211,507	2,570	12,724[4]	....	1,950	232,277	244,088	−11,392
Delta	152,000	1,000	....	8,000	....	177,000	304,000	−134,000
Eastern	2,157,139	50,989	121,366[4]	....	....	2,332,453	2,686,954	−399,874
Mackey	75,292	....	405	2,779	....	86,591	156,938	−70,347[3]
National	167,581	515	....	2,624	....	194,114	136,972	57,142
Northwest	1,522,946	536,507	373,304[4]	....	....	2,494,072	2,584,493	−122,871
Pan American Combined	26,691,000	2,289,000	....	4,030,000	1,584,000	35,973,000	34,804,000	441,000
Alaska	295,000	15,000	....	48,000	....	348,000	473,000	−123,000
Atlantic	13,612,000	1,059,000	....	1,565,000	342,000	17,348,000	16,291,000	1,105,000
Latin American	5,203,000	208,000	....	1,231,000	340,000	7,475,000	9,186,000	−1,709,000
Pacific	7,581,000	1,007,000	....	1,186,000	902,000	10,802,000	8,842,000	2,006,000
Panagra	1,315,000	59,000	....	192,000	3,000	1,756,000	1,841,000	−127,000
Resort	....	....	....	....	8,422[7]	8,422	17,780	−8,074
Trans Caribbean	408,637	....	71,910[4]	....	6,904	519,480	510,836	49,548
Trans World	6,628,061	713,379	635,080[4]	....	613,176	8,918,513	7,744,065	1,174,448
United	2,193,542	87,718	48,965[4]	....	....	2,357,830	1,708,495	612,663
Western	298,292	3,132	8,215[4]	....	....	311,560	397,738	−92,496
LOCAL SERVICE								
Allegheny	1,009,676	10,700	21,152	33,935	5,561[2]	1,384,941	1,565,596	−180,655[3]
Bonanza	430,304	3,239	4,230	5,685	6,512	749,717	639,708	109,841
Central	218,792	7,490	3,665	10,557	16,255	522,658	471,173	51,484[3]
Frontier	592,112	15,425	4,635	28,745	11,331	1,196,874	1,116,179	67,312
Lake Central	265,110	6,433	9,653	....	1,372	431,400	403,548	27,852[3]
Mohawk	948,185	14,135	18,637	17,204	54,367	1,289,149	1,223,053	66,096[3]
North Central	1,113,264	30,614	25,000	30,070	10,622[2]	1,751,853	1,862,158	−125,322
Ozark	739,146	14,000	15,681	21,955	20,407	1,142,764	1,038,047	104,717[3]
Pacific	567,226	11,900	4,240	5,382	46,987	914,943	967,718	−78,525
Piedmont[6]	673,024	10,236	8,293	11,958	31,306[2]	1,123,401	1,020,308	90,176
Southern[1]	....	....	....	....	....	....	....	....
Trans-Texas	486,271	9,971	8,402	18,980	14,856	801,629	731,448	69,658
West Coast	542,039	11,463	3,490	11,247	523	1,032,614	919,080	148,971
HAWAIIAN								
Aloha	385,181	2,897	....	5,707	475[2]	420,777	443,004	−22,227[3]
Hawaiian	562,843	2,897	....	68,619	153,131[2]	767,153	819,067	−51,914[3]
CARGO LINES								
AAXICO	....	....	....	....	2,878	97,581	75,607	21,974
Aerovias Sud Americana[1]	....	....	....	....	....	....	....	....
Flying Tiger	....	11,867	1,140,563[4]	....	1,704,881	2,872,869	2,511,409	333,494
Riddle	....	....	....	649,762	....	659,822	789,923	−130,101[3]
Seaboard & Western[1]	....	....	....	....	....	....	....	....
Slick	....	....	....	....	....	1,901,112	1,577,728	323,384[3]
HELICOPTER LINES								
Chicago Helicopter	177,749	135,898	....	....	....	313,657	298,746	13,682
Los Angeles Airways	16,375	13,418	13,662[5]	....	....	135,441	125,486	12,105
New York Airways	97,216	1,543	3,173	3,571	....	310,322	296,174	13,227
ALASKA LINES								
Alaska Airlines	200,799	61,116	1,476	54,201	283,654	765,934	728,684	22,109
Alaska Coastal	74,204	10,063	....	9,495	4,220	144,013	164,760	−20,747[3]
Cordova	17,905	14,856	....	14,383	22,951	102,218	92,890	7,739
Ellis	44,200	3,700	....	6,400	1,200	88,400	100,740	−12,340[3]
Northern Consolidated	69,891	54,989	....	36,810	5,710[2]	222,180	259,041	−36,861[3]
Pacific Northern	561,620	87,078	4,130	117,970	465	902,348	928,392	−32,962
Reeve Aleutian	128,093	40,694	....	45,606[8]	11,489	228,305	200,508	26,501
Western Alaska[9]	62,718	14,432	....	8,136[8]	33,128	163,980	128,476	35,503[3]
Wien Alaska	62,804	44,868	....	30,410	24,787	280,843	378,509	−97,667[3]
Avalon Air Transport[1]	....	....	....	....	....	....	....	....

[1] Not available. [2] Non scheduled transportation or other transportation. [3] Operating profit or loss. [4] Property. [5] Express & excess baggage. [6] Airline division operations. [7] Incidental revenue. [8] Freight & excess baggage. [9] Period Feb. 27 thru Oct. 31.

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SPACE TECHNOLOGY

Anti-Radiation Shielding May Be Reduced

By Erwin J. Bulban

Brooks AFB, Tex.—Use of heavy anti-radiation shielding may not be necessary for protection of astronauts, at least for trips of less than 50 hr., postflight studies of human tissue and other specimens which orbited the earth aboard the Discoverer XVII satellite in November indicate.

Medical technicians who have analyzed behavior of the specimens here at USAF's Aerospace Medical Center, which prepared them for flight, go a step further in their comments. They indicate, in fact, that heavy shielding may be harmful.

"It may be safer to reduce it [shielding], and let the radiation pass through the astronaut's body, than to have the primary radiation stop in the body and/or have the astronaut receive a significant dose from secondary radiation produced," Dr. George W. Crawford, nuclear physicist at the School of Aviation Medicine's Department of Radiobiology, stated.

Significance of the data lies in the fact that the specimens prepared by technicians here were in space during one of the largest solar flares ever recorded and were exposed to the radiations of this flare for 50 hr., starting 7 hr. after the flare began. This was the first time that specimens from this country were exposed to a solar flare of this magnitude for such an extended time period and recovered for detailed laboratory analysis.

Some specimens were encased in different types of metals to test their effectiveness as shielding materials, while other specimens were shielded only by the thin aluminum covering of the specimen capsule inserted in the Discoverer satellite.

Analysis indicates that the specimens protected by the aluminum took a lower dose than those with lead shielding, according to Dr. Crawford. He pointed out that heavy metals such as gold or lead become a hazard during a solar flare as high energy protons interact with these heavy materials to create damaging X-rays. "This does not occur with the lighter metals or plastics," he said.

Specimens contained in the 3-lb. aluminum capsule in Discoverer XVII included:

- **Living human cells** that had originated from the synovial lining of a bone joint and from the conjunctival lining of the eye were grown artificially in a special chamber. On the 12th day after preparation the cultures were sent aloft in the satellite and were returned to the USAF laboratory here on the 16th day after preparation. Preliminary investigation indicated that they were in an advanced state of degeneration, but on the 12th day after arrival, signs of survival appeared. The 20th day after arrival, there was definite new growth in the flight cultures, cells were undergoing multiplication and were moving about. It is believed that the initial poor appearance of the specimens was largely due to exhaustion of the special nutrient media in the long time interval that elapsed before they were returned to the laboratory and re-feeding permitted survival of some cells to occur. Radiation alone cannot be held responsible for the cellular damage and death that did occur, laboratory technicians point out.
- **Essential substances** from human and animal bloods were experimentally placed on absorbent paper and packaged with a radio-sensitive material to record cosmic hits. Postflight observation of the radio-sensitive material indicated considerable cosmic bombardment; no valid differences were detected between exposed and non-exposed bloods similarly prepared, Dr. J. L. Flume, Immunology Section, reported.
- **Bacterial spores,** of the species clostridium sporogenes and relatives of bacteria common to soil, were sealed in glass vials for the flight. These heat-resistant spores, upon return to the laboratory, were put into a test tube containing a very hot solution of carmelized sugar. Spores that also had been shipped to Vandenberg AFB, Calif., but had not flown on the satellite, also were returned and placed in a similar solution as a control. Practically all of the control cells were killed rapidly by the solution. In contrast, most of the spores returned from space survived their postflight treatment in the solution. This result appears to bear out studies recently carried out by the School of Aviation Medicine which shows that radiation acts to inhibit the killing activity of carmelized sugar on bacterial sports, and accumulated data now indicate that this particular spore system may be useful as a biological index of the space radiation hazard, Maj. Irving Davis, chief, Astromicrobiology Section and Thomas Roberts, microbiologist, suggest.
- **Algae carried aloft** in the Discoverer XVII experiment, indicated that they are able to exist and function virtually unchanged in an actual space environment, backing up similar findings that had been developed with cyclotron experiments under controlled conditions, according to Dr. J. Neal Phillips, Jr., space ecology specialist.

Specimens received not more than 30-35 RAD during the 50 hr. they were in space. Eight different types of dosimeters were flown and the whole body radiation dose received inside the capsule was measured by four independent means.

Subsequent evaluation also indicates:

- **No electrons** entered the aluminum can although electron fluxes up to 10 electrons per centimeter squared per second are reported in the other Van

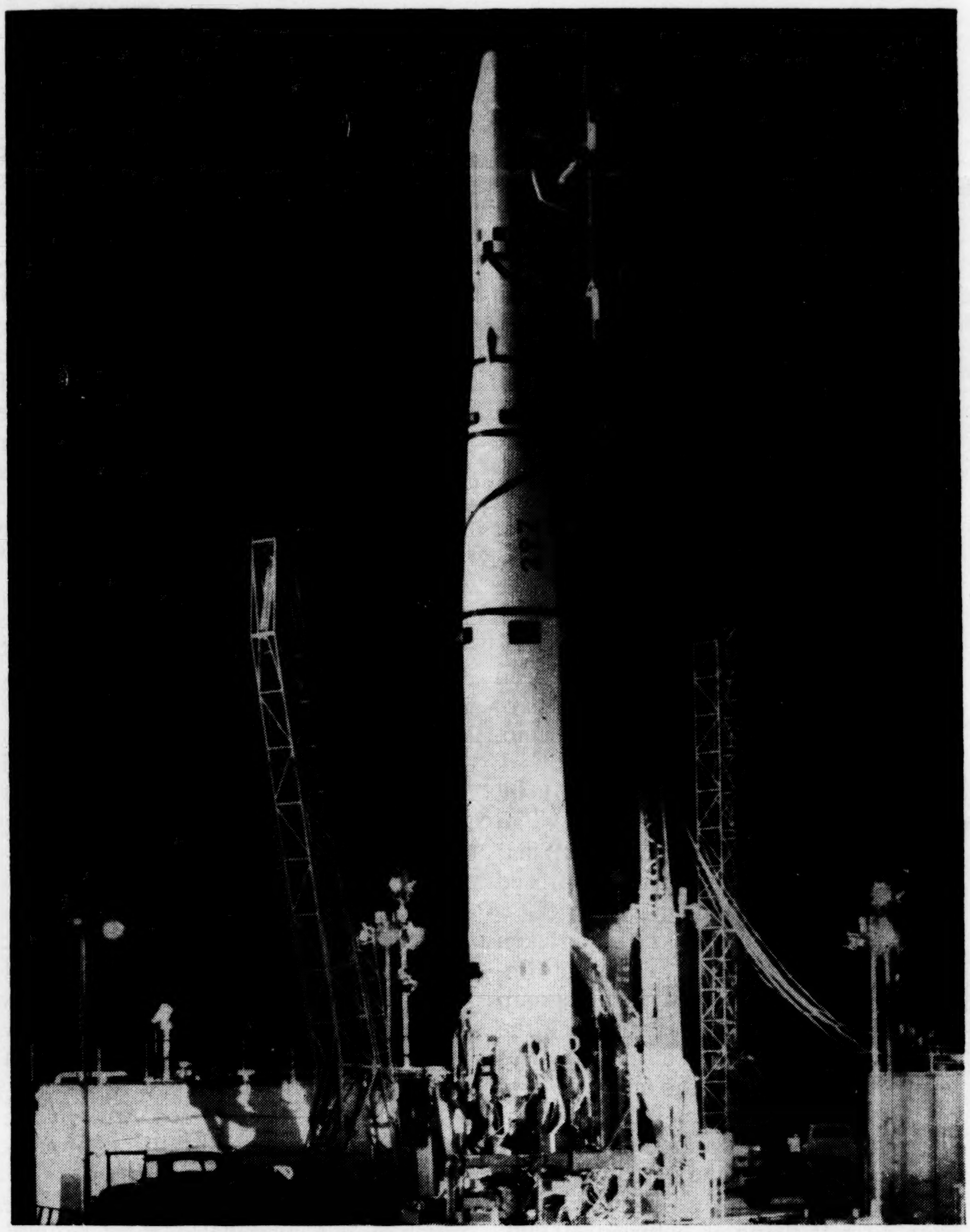
Electronic Spin Chair

Brooks AFB, Tex.—An electronically controlled spin chair designed to provide USAF aerospace medical technicians with advanced data on the reasons for pilot disorientation and make it possible to develop at least partial immunity to this problem will be installed here at the Air Force School of Aviation Medicine.

The apparatus consists of a specially padded, adjustable chair in which the subject can be rotated in a vertical axis. It is powered by an electro-hydraulic system and will be controlled by an electronic computer. The operator can feed data on the program he wants into the computer. By pushing a button the system is activated and the chair goes through the desired gyrations with direction, intensity and duration of accelerations which are precision controlled.

The accelerator will be used in a long-range vestibular research program to study the effects of spatial motion on the human inner ear, or vestibule, which contains tiny organs that sense when, how fast, and in what direction a person is moving. In a fast-moving vehicle, these organs can give false reports which can be fatal to a pilot flying on instruments.

USAF medical technicians hope to learn more about the vestibule and how it may be controlled so that these false reports are lessened. Laboratory tests here at the school indicate that repeated exposure to disorientation spins can partially protect a person against the phenomenon and that experienced pilots are less prone to this problem.



Pre-Launch View of Discoverer XVII

Discoverer XVII is shown poised on launching pad at Vandenberg AFB, Calif., prior to successful firing with a modified Douglas SM-73 Thor booster, 10 ft. shorter than Thor boosters used to launch Agena A Discoverers (AW Nov. 21, p. 33).

Allen belt. The can passed through the horns of the belt four times on each of the 31 orbits.

- **No Bremsstrahlung** from electrons being stopped in the walls of the can were observed.
- **No neutrons** were detected by either of two independent measurements.
- **A total of almost 10** to the sixth power heavy nucleon hits per square centimeter was estimated from a study of four films.
- **Three dimensional** arrays of dosimeters failed to detect any dimensional effect and the radiation dose was almost uniform through the can except where lead had been used as part of the step plate shielding experiments.
- **In the localized** regions where lead or other materials were placed, X-rays were measured. Such proton Bremsstrahlung requires proton energies above 1 billion electron volts. Thus use of lead, gold or other heavy metals for shielding during solar flare will cause production of proton Bremsstrahlung not produced in light metal such as aluminum, or in plastic materials.
- **Total proton flux** was about 6 x 10 to the eighth power protons per square centimeter.

Navy Space Program Gets Budget Increase

Washington—Navy astronautics program is slated to get its first substantial financial support with the $11 million earmarked for it in Fiscal 1962, and it will be aimed at using new avionic miniaturization techniques to produce smaller, cheaper satellites for operation in orbits up to 500 mi.

Jumping from well under $1 million this year, the astronautics program will support a variety of studies aimed at capitalizing on avionic component microminiaturization breakthroughs to cut satellite size and cost. Although definite requirements have not yet been generated in all areas, the Navy has decided it needs navigation, communications and weather satellites to support fleet operations.

Navy wants to put several dozen 100-300 lb. satellites a year into low orbits, and they would be launched at sea with the Sea Scout. This four-stage vehicle consists of the two Polaris missile stages, plus the two upper stages of the Air Force Blue Scout solid-fuel launch vehicle. It would put 150 lb. in a 300 naut. mi. orbit.

Sea Scout could be launched from a ship like the USS Observation Island, which has been used in Polaris missile test firings. Navy points out that the flexibility of sea launching would make the Sea Scout valuable for communications satellite programs calling for equatorial orbits. Sea Launch from the equator would eliminate the expense of building dog-leg capability in the vehicle guidance system.

In the field of anti-satellite weapons, the Navy believes it has a feasible low cost system, Project Skipper, which envisions a vertical probe, or space mine, which would place a cloud of small shot in the path of a satellite. Since the satellite would be traveling at very high speed, it would destroy itself when it hit the cloud of shot. Navy contends this approach would eliminate any need for complex rendezvous systems for anti-satellite work.

A Navy communications satellite would supplement and complement Army and National Aeronautics and Space Administration programs. In addition it would tie in with Project Lofti, which is aimed at determining the propagation and transmission characteristics of very low frequency electromagnetic waves in, through and from beyond the ionosphere. At present, Lofti packages are planned for piggyback rides on future Transit navigation satellite shots.

For reconnaissance, Navy's Project Yo-Yo involves a single pass satellite which would accomplish its mission on its first trip, eliminating the hazards of an enemy tracking and destroying it.

A weather satellite, called Project Renae and under study by Radio Corporation of America, would be intended to observe weather conditions in remote sea areas for coordination with the fleet tactical data systems.

The most active current Navy space program is the Transit navigation satellite, which is funded separately from the astronautics program. Research, development, test and evaluation phase of the Transit program is budgeted for $17 million in Fiscal 1962, and another $5.3 million is allotted for the operational phase.

British Scout Satellite in Development

By John Tunstall

London—Construction and testing of prototype equipment for the British instrumented Scout satellite is now under way following complete agreement between the British National Committee on Space Research and National Aeronautics and Space Administration in Washington on the suitability and practicability of the proposed experimental program.

According to an Aviation Week survey, new techniques and novel equipment have been developed in the U. K. for the British program which will primarily be concerned with studies of electron temperatures and densities, ion energy distribution and mass spectrum in the ionosphere.

The program will also include a major study of the cosmic ray energy spectrum of a type which has not been previously attempted.

Distinguishing Feature

One of the main distinguishing features of the British instrumentation is the provision of differentiating circuits within the satellite—largely for the first time—which enable the probe current voltage curves to be analyzed and reduced before telemetering. Notable detail of the cosmic ray instrumentation centers on the use of a particle counter employing the Cherenkov light emission effect.

But as Prof. J. Sayers who heads one of the three participating university groups put it, "the satellite will not be going anywhere new and much of the ionospheric results will be largely confirmatory."

The satellite, S-51, will be a cylinder two feet in diameter with hemispherical ends. Instrument load will weigh about 20 lb. and the weight of the satellite structure, telemetry and solar power supplies, all of which will be supplied by the United States, totals 100 lb.

The tape recorder in the satellite will respond to ground command stations, one of which will be located at the U. K. radio research station at Slough.

Launching of the Scout four-stage rocket is expected from Wallops Island, Va., within the next 12 months.

The selection of the groups has been confined to those workers who have already obtained experience in ionospheric investigations with Skylark rockets and in the plasma physics field. The experimental program is in fact an extension of the Woomera (Australia) rocket program studies, using improved techniques and equipment.

Cosmic ray studies will be undertaken by a group under Prof. Elliot of Imperial College, London. The group hopes to establish the way in which the cosmic ray energy spectrum changes with solar activity and the major novelty of the group's approach lies in its intention of correlating measurements of the spectrum from the satellite with a series of simulataneous measurements from aircraft flying at between 40,000-50,000 ft.

By suitable correlation between the two measurements of variations, it is hoped that future measurements of the nature of the primary spectrum can be deduced from aircraft measurements alone.

The primary spectrum—which is the number of particles of a given velocity—can be found by observing the primary spectrum variations with latitude, these variations being due to the effects of the earth's magnetic field. Only the energetic particles can get through near the poles. By comparing the numbers measured at different latitudes the number of particles in a particular energy band will be deduced.

Cherenkov Detector

Prof. Elliot told Aviation Week that the group has developed a "particularly clean way" of looking at the heavy cosmic particles beyond carbon. It is based on a Cherenkov detector and counter which Elliot believes has not previously been used in a satellite. The instrument consists of a four-inch plastic sphere and a photomultiplier. Heavy particles moving with speeds approaching that of light pass through the plastic at speeds in excess of the speed of light in the material. In the process of slowing down in the plastic, energy release in the form of light emission occurs—the Cherenkov effect.

The light is scattered within the sphere and presented to the photomultiplier.

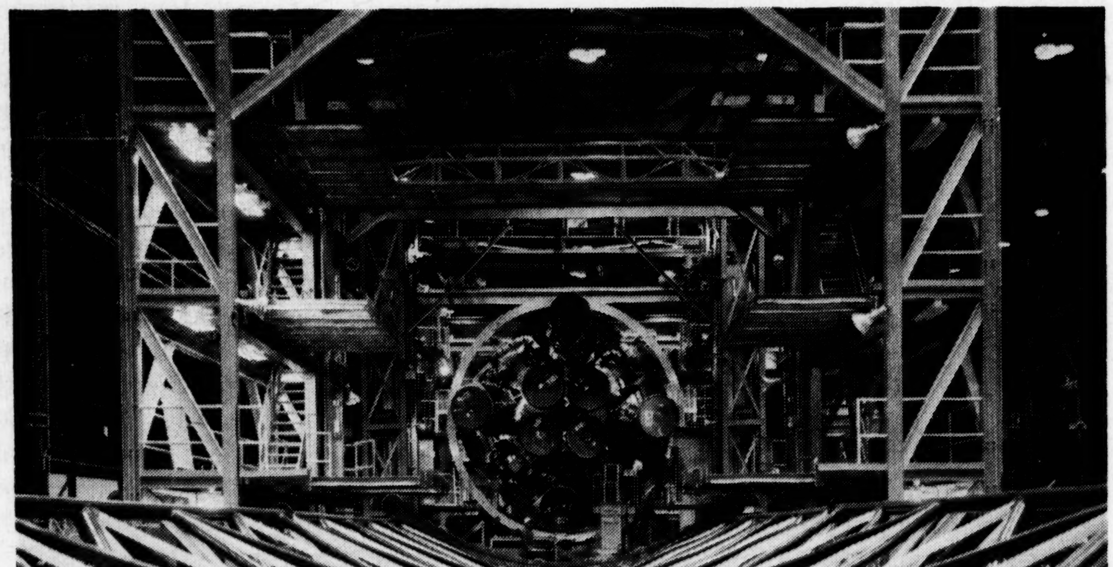
Flashes from the heavy primaries are much more powerful than those emitted by the smaller particles and the circuitry can be gated so that only the heavy particles will be counted.

This ability to discriminate in favor of the heavy particles is the main advantage of the detector over more conventional Geiger and scintillation counters. Scintillators have tended to confuse previous measurements, said Elliott, because the slower the particle, the bigger the pulse. "The Cherenkov detector is blind to the unwanted muck."

Because no equipment like the detector has yet flown it is intended to test the design in a Black Knight firing, before it is committed to the satellite.

Long-term objective of the Imperial College group is the relation of the changes in the primary spectrum to the changes in the strength and configuration of the interplanetary magnetic field.

The ionospheric studies will be undertaken by two groups from University College, London, under Dr. R. L. F. Boyd, and the University of Birmingham under Prof. Sayers. One of the main ionospheric experiments by these two groups will be the measurement of electron density using two different techniques in an integrated "probe and



Second Saturn Booster Assembly Fixture

Second Saturn booster assembly fixture neared completion this week at the Marshall Space Flight Center, as the first Saturn rocket to be flight tested entered its final stages of assembly. Besides supporting and rotating the booster during assembly operations, the dual-purpose fixture is equipped with running gears to serve as the rocket's transportation trailer.

capacitance" set of experiments. The results will be correlated.

Another group of experiments by University College aims to measure both the ion energy spectrum and the ion mass spectrum.

At the same time the University College group will look at the ultraviolet and X-radiation from the sun in order to correlate radiations from the sun with the properties of the ionosphere.

The method of studying the local free electron population density in space adopted by the Birmingham group does not depend on conventional laboratory probe techniques, but on the change in dielectric constant which the particles produce in the medium within which they are present.

This method of electron density measurement was pioneered by Birmingham University and first proved in Skylarks from Woomera some years ago. Although the U. S. has now taken up the method, Sayers said, the actual system to be employed in the Scout satellite is a far more accurate development of the original system. Sayers wouldn't say that the group had maintained its lead, but he said, "We have been doing it longest, and we have most experience of the method."

Density Measurement

Density is measured by capacitance, the efficiency of the plasma between the plates as a dielectric being proportional to electron density. To obtain a reference value, the atmosphere between and surrounding the plates of the capacitor will be "swept clear of electrons" every four seconds by biasing the electrode voltage and the recording system automatically zeroed.

The apparatus consists of two sensing electrodes of a few square inches each placed a few inches apart and connected to a radio frequency source of 10 mc.

Under the influence of the alternating field associated with the plates the electrons oscillate between the plates in synchronism with the field. The oscillation of the charged particles within the electric field thereby induces small alternating (induction) current to flow to the electrodes.

This alternating induced current is amplified electronically within the satellite and represented as a d.c. voltage which is proportional to the electron density.

Several factors determine the frequency of the exciting source, Sayers explained. For reasons of data reduction the frequency must be considerably above that of the critical radio wave propagation frequency. It is also related to collision probability.

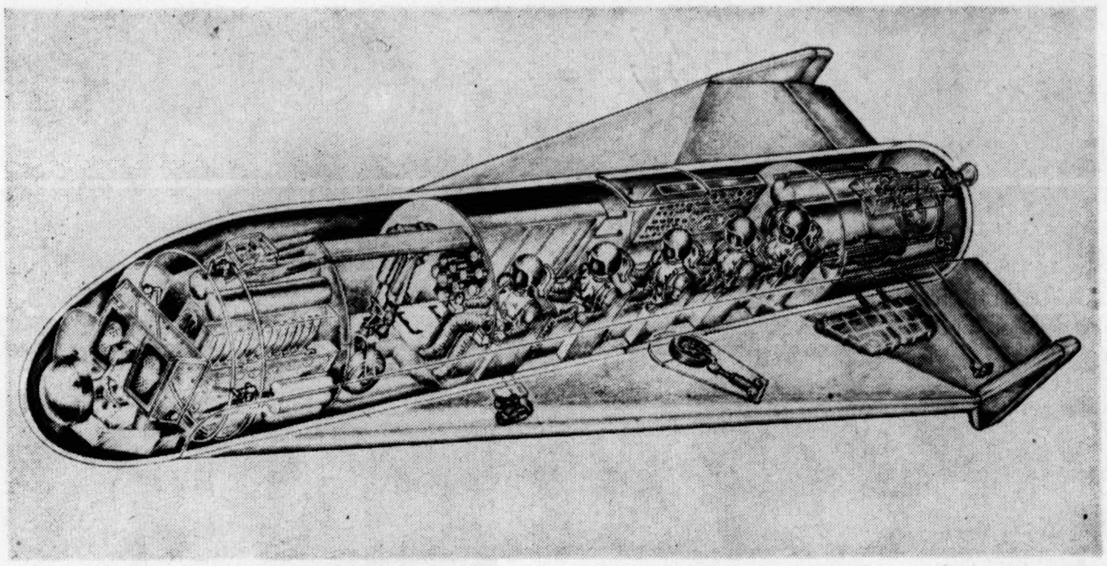
The frequency also affects the ratio of the induced current to the normal current flowing to the electrodes. At 10 mc. the induced current flow is of the order of the capacitance plate current. Much greater frequencies would result in the electron-induced current being very small compared with the normal circuit current.

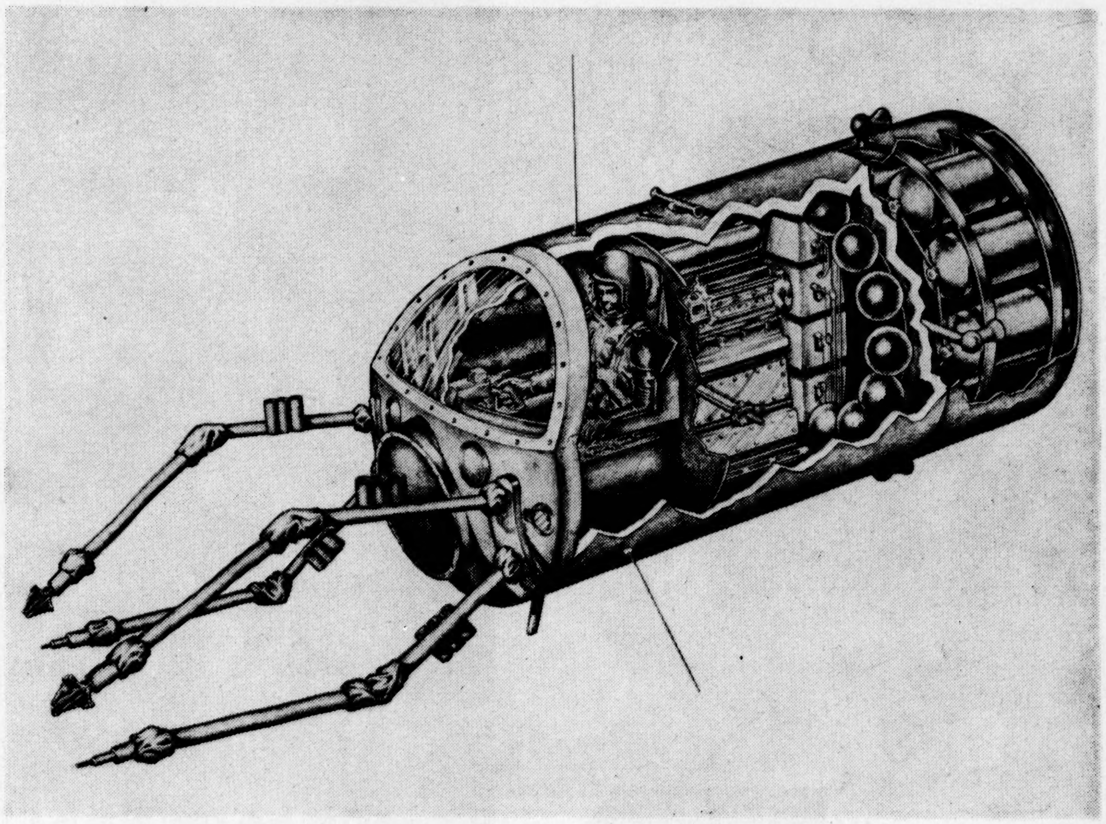
This capacitance technique has already been compared with a development of the Langmuir probe technique which is used by the University College group. The cross-check was carried out under laboratory conditions simulating ionosphere temperatures and pressures and gave precise agreement, according to Dr. Boyd.

The capacitance technique appears to be both slightly heavier and more complicated but as both will be differently effected by ionospheric conditions the behavior of the two equipments in orbit will ultimately decide the most suitable approach.

Validity of the capacitance method has already been proved in a Black Knight firing in which the nose cone acted as one probe and the rest of the rocket as the other.

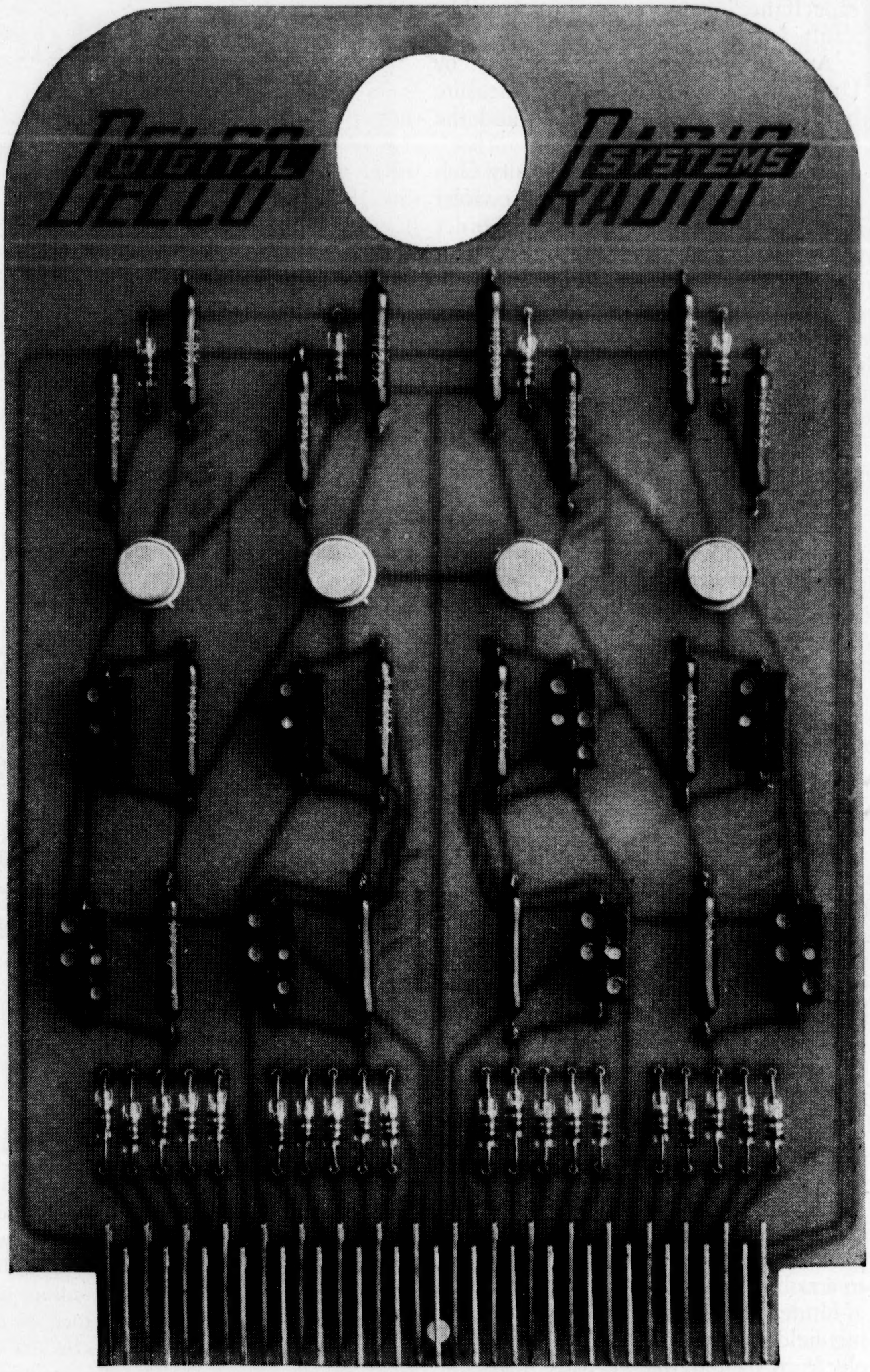
The electrode boom of the capacitance equipment is retracted during

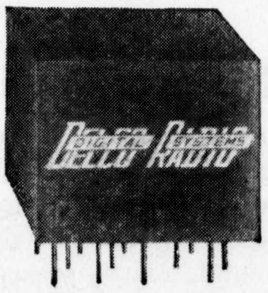




Martin Studies SLOMAR Space Vehicle Designs

Air Force's Wright Air Development Division has negotiated contracts totaling $600,000 to study the need and design for a space logistics, maintenance and rescue (SLOMAR) system which would service spacecraft foreseen in the next 15 years. Martin, Douglas and Norair will make the study under $140,000 contracts; Lockheed and Convair have $90,000 awards, and General Electric's contract is unfunded. Martin concepts are shown. Shuttle vehicle above would carry five men or cargo payload to rendezvous with orbiting space station, then glide to earth. Martin one-man space tug below would be used to assemble a space station in orbit. The companies were selected for SLOMAR studies several months ago (AW Oct. 24, p. 23) and negotiations were completed in mid-December. Program studies include orbital mechanics, environmental subsystems, navigational and radar systems, vehicle homing and lock-on system, space payload transfer subsystem, techniques for maintenance, solar radiation, and stabilization and control propulsion. Also required is a study of pilot escape during boost and re-entry. Studies will consider use of nuclear propulsion for upper stages and auxiliary power.





DIGITAL MODULES

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Which package fits into your design? Packaged either way, Delco Radio Digital Modules meet or exceed all MIL-E-5272D (ASG) environmental requirements. Continuing life tests on these computer circuits now exceed four and one-half million transistor hours *without a failure*. The modules perform all the standard logic functions and come in many basic types and variations. Delco modules in the transistorized building block package are ideally suited for airborne guidance and control because of their extreme ruggedness, compactness and reliability. All miniature building block modules employ three dimensional welded wiring techniques and are vacuum encapsulated in epoxy resin. Delco Radio can offer you off-the-shelf digital circuits packaged as building blocks or plug-in cards, or can supply circuits to meet your specific needs. Our Sales Department will be happy to send you complete engineering data. Just write or call. ■ *Physicists and electronics engineers: Join Delco Radio's search for new and better products through Solid State Physics.*

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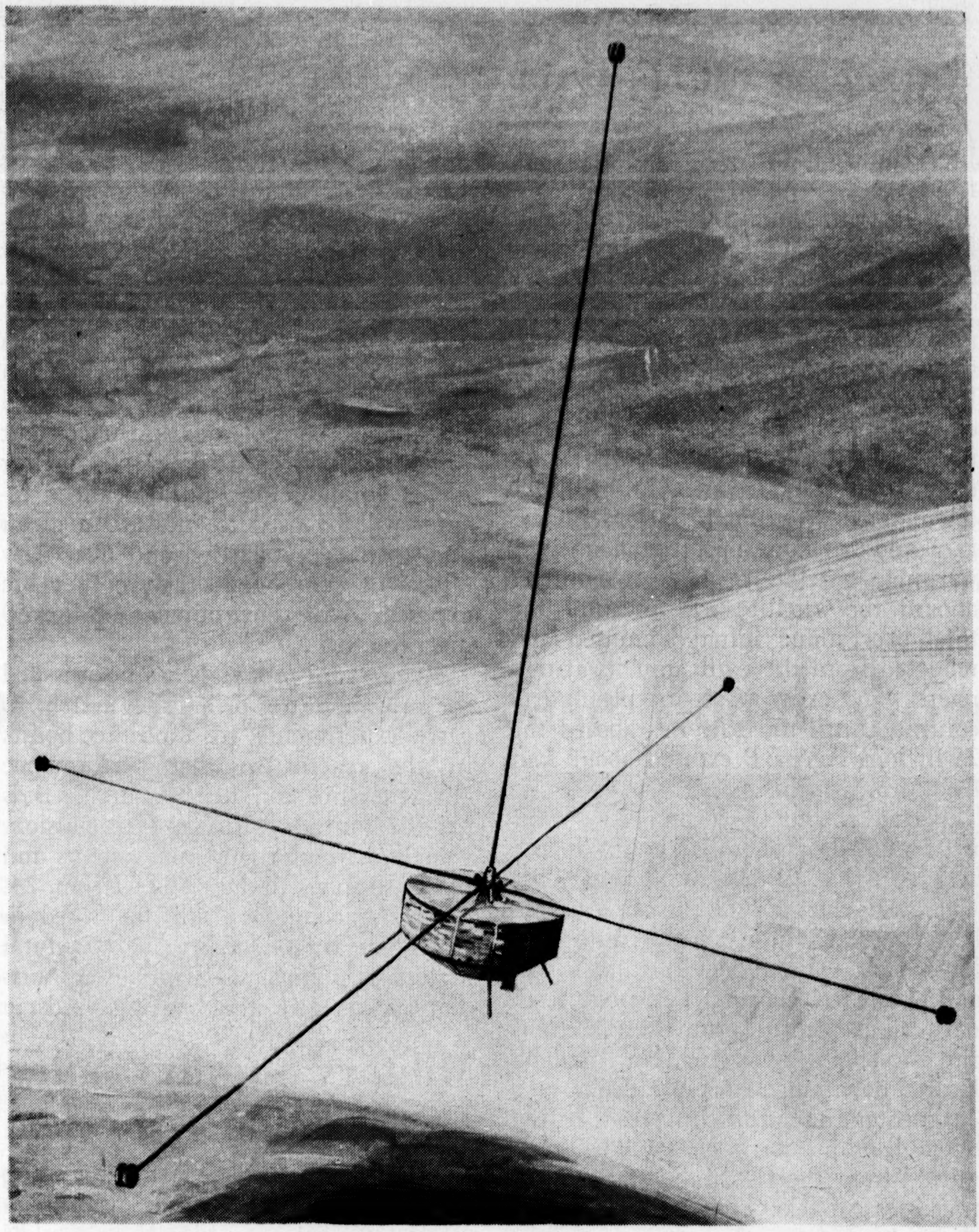


Device Proposed to Orient Satellite

Satellite-orienting device proposed by Convair-Astronautics design specialist Lawrence J. Kamm consists of a 100-ft. primary tube which unrolls from satellite top, and four shorter sway-damping tubes which unroll horizontally. Top tube, made of thin stainless steel, glass-fiber laminate or beryllium-copper, is coiled flat but becomes tubular when unrolled by elastic stresses. Design is based on theory that gravity exerts a stronger pull on the end of a satellite closest to a planet, while centrifugal force keeps opposite end of elongated satellite pointed away from the planet.

launching. As fitted to the Skylark rocket the complete transistorized electronics package weighed 1½ lb. with batteries. Sensitivity of the equipment will enable electron densities down to a few thousand per cubic centimeter to be measured and is therefore suitable for satellites of highly eccentric orbits or in deep probes.

The University College group will use highly developed forms of the Langmuir probe technique in its ionospheric measurements. These were originally devised by the college's physics department for plasma investigations in discharge tubes. Using complex and powerful electronic methods, the technique enables the contribution of heavy negative ions to the probe current to be distinguished from that of much lighter electrons, in the probe current-voltage curve.

The equipment will be used to measure electron temperature, and the same technique will be used in an analysis of the ion energy spectrum.

The determination of the ion mass spectrum by this technique is based on the fact that the energy with which an ion impacts a satellite is approximately half the product of the ion mass and the velocity of the satellite squared.

Radiation Measurement

Another major experiment of this group will be the measuring of the fluxes of Lyman-Alpha radiation and soft X-rays, using equipments which have already been used in the Skylark firings.

Dr. Boyd emphasized the distinguishing features of the ion mass and ion electron temperature measuring equipment in Scout to be the differential analysis of the probe current-voltage curve aboard the satellite and the use of a subtle differential technique which was not time dependent.

Using the normal Langmuir probe technique, electron temperature is derived directly from the ratio of the first and second derivatives of the (I-V) current-voltage curve of the probe electrode. Previous workers have attempted to analyze the curve by double graphical differentiation on the ground from the current data telemetered from the vehicle. This is just not possible, Boyd says, due to the noise signal ratio. Furthermore it is affected by variations in the vehicle potential which tend to swamp the effects it is desired to measure.

Boyd's modification of the Langmuir probe technique enables the I-V probe curve to be analyzed on board, and its second derivative which contains much of the energy information telemetered directly.

The computing technique which has not been widely used is based on the fact that if two voltages of different frequency are applied to the probe, they mix, giving a modulated wave, the degree of modulation being proportional to the second derivative of the I-V curve. This follows from the fact that if the modulated wave is passed through an amplifier with automatic volume control, the arc takes the ratio of the first and second derivatives.

The first derivative gives the amplitude of the main wave and the second derivative gives the modulation. Hence the ratio is proportional to the percentage depth of the modulation, and hence to electron temperature.

The ion energy spectrum from which the mass spectrum can be obtained directly is obtained by an identical analysis of a screened spherical probe I-V curve, the probe being located on the spin axes of the vehicle. The energy spectrum is contained in the value of the second derivative, the ratio of the two derivatives again being proportional to the ion temperature.

Plotting the value of the second derivative against voltage gives the ion energy spectrum. Because the vehicle has hypersonic velocities greatly in excess of the mean random speed of the ions it follows that the impact energy (with due correction for satellite charge) is approximately half the product of the ion mass and the satellite velocity and so the mass spectrum can be deduced directly from the energy spectrum.

As the computation method does not involve differentiation with respect to time it avoids the introduction of complications due to other time dependent parameters such as the vehicle motion.

Discoverer XIX Gathering Midas Data

Los Angeles—Discoverer XIX satellite, launched into an elliptical orbit from Vandenberg AFB on Dec. 20, has some scientific objectives but primarily is gathering data for the Midas early warning program.

The satellite carries infrared equipment similar to that planned for Midas satellites. Unlike earlier flights in the Discoverer program, there will be no effort to recover a data capsule from the 2,100-lb. Agena B spacecraft. All data from Discoverer XIX will be telemetered to ground stations just as it would from an operational military warning satellite. The radiometer aboard the satellite will measure the total background infrared emitted and reflected from the earth and its atmosphere. The experiment was planned to continue until the batteries aboard the 25-ft. long Agena B expired about four days after launch.

Period of the Discoverer XIX orbit is 93 min. Its apogee is about 400 mi. and its perigee is 130 mi. The satellite will be tracked by stations at Vandenberg AFB, Pt. Mugu Naval Missile Center, Kodiak, Alaska, New Boston, N. H., and Kaena Pt., Hawaii. Telemetry readout will be provided by these stations and the telemetry ship USNS Richfield located downrange from Vandenberg.

Ignition and cutoff commands to the Agena B propulsion system will be transmitted from the Pt. Mugu station. All tracking and telemetry data will be retransmitted from the stations to the USAF Satellite Test Center at Sunnyvale, Calif., where USAF has been using the Discoverer program to build the technical and management skills that will be needed by military units launching and operating Midas and Samos satellite systems.

First developmental models of Midas and Samos will be launched from naval missile facility at Pt. Arguello, the Pacific Missile Range base immediately south of Vandenberg. The orbits of Midas vehicles will be planned to enable USAF to observe all the earth with about 10 satellites in polar orbits.

Plum Brook Reactor To Operate in March

Washington—Nuclear fuel will be loaded in the Plum Brook reactor in mid-March as the National Aeronautics and Space Administration begins to shape its program to develop nonnuclear components for nuclear space propulsion systems.

Atomic Energy Commission hearing board granted NASA a provisional permit to operate the 60 mw., water-cooled test reactor after hearings completed Dec. 16, and physicists now are preparing to begin criticality tests within 90 days.

In developments associated with operation of the reactor, NASA's Lewis Research Center recently awarded a contract for a zero-power mockup reactor, and plans to select a contractor early next year for a component handling device.

Lockheed Aircraft's Georgia Division has a $404,002 contract to build a zero-power reactor which will be used to calibrate control rods and check out initial feasibility of potential nuclear rocket components. The Lockheed reactor will be used to measure neutron and gamma properties and reactivity effects of components before they are exposed to the environment of the 60 mw. reactor.

Request for proposals has been issued for an underwater propulsion system to carry experiments to exposure points in the reactor so that performance characteristics can be measured. Bids for the unit, consisting of propulsion, vehicle drive and guidance systems and power supply, are due at Lewis Jan. 24.

Among components to be tested in the Plum Brook facility are structural materials, pumps, seals, shielding, auxiliary power gear and working fluids.

Military Supply Center Uses Computer System

Washington—New data processing system which performs the role of an electronic catalog for the world's largest shopping list has gone into operation here at the Armed Forces Supply Support Center (AFSSC).

The new AFSSC facility will keep a running up-to-the-minute inventory of some 3.5 million items used by the armed services which will be stored on 218 reels of magnetic tape. The new equipment, which can handle 100,000 individual supply management actions per day, is built around an International Business Machines Corp. IBM 705 III large-scale computer and three smaller IBM 1401 systems, one of which is now installed. Other two are slated for operation by next July.

Some of the management-supply services which the new system can provide quickly upon request include:

- **List of users,** location and amount of excess inventory (if any) of every item listed in the federal catalog. This will minimize unnecessary duplicate procurements and permit speedy access to available supplies.
- **List of items** by manufacturer's part number, giving corresponding federal stock number. This is expected to be particularly useful in provisioning spare parts for new weapon systems and equipments which use standard parts already in the inventory for other weapons or equipments. Results to date indicate that up to 30% of new weapon parts already exist in the federal inventory.

The new AFSSC data-processing system replaces an earlier punched-card system installed in December, 1956. The initial system, which used punched cards providing identification data for about 60% of the items in the inventory, slashed center manpower requirements by two-thirds and reduced time required to handle inquiries by more than half, the agency says. Equally important, the system installed four years ago greatly reduced human errors.

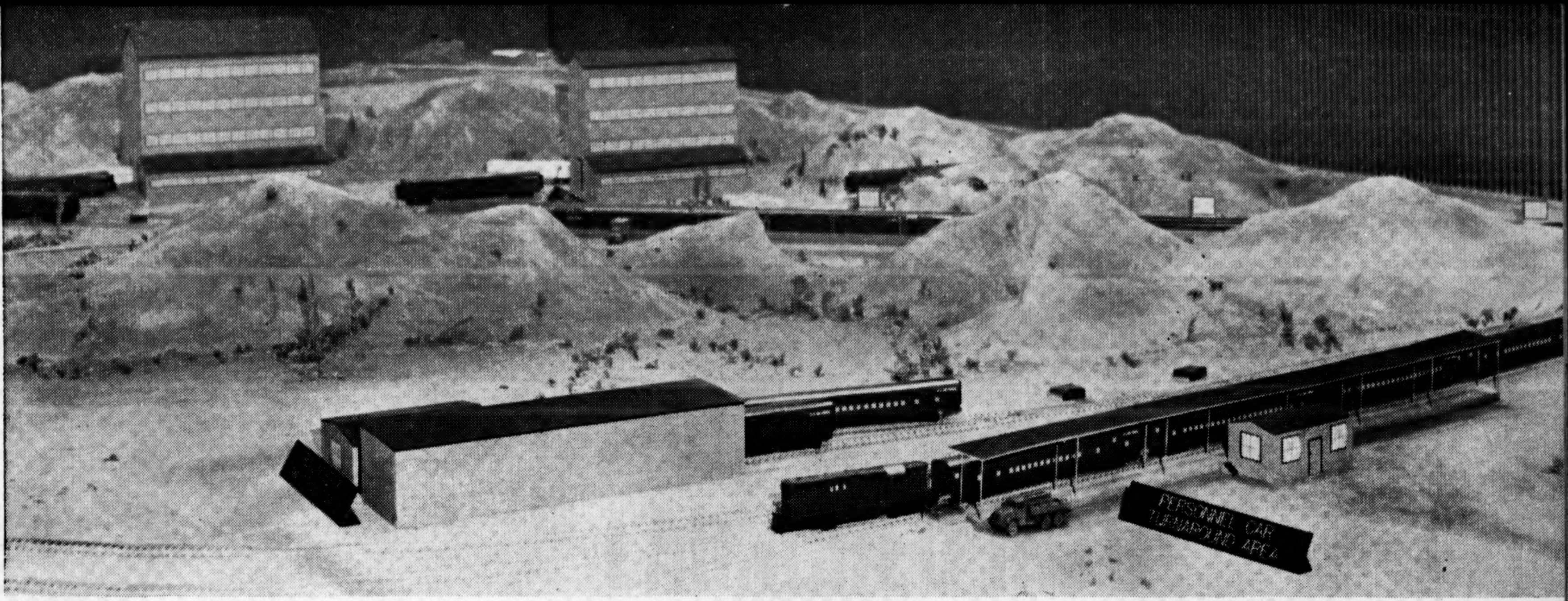
Use of the early system increased so rapidly that it was soon being operated 24 hr. per day, seven days per week, making it difficult to find time for maintenance routines. The new IBM equipment is expected to handle the present work load in a 16-hr. day, five-day week work period, providing surplus time for providing new management control data.

The AFSSC facility serves 90 government/military activities, including the Atomic Energy Commission, National Aeronautics and Space Administration, General Services Administration and National Security Agency in addition to the military services. The AFSSC facility is linked to 35 communications centers by means of special dial telephone data transmission equipment which enables the centers to communicate directly with the intermediate size IBM 1401 computers. The 1401 system checks incoming queries and data for validity and arranges them into a format which can be used by the larger IBM 705 III.

System Designed to Purify Air Inside Space Capsule

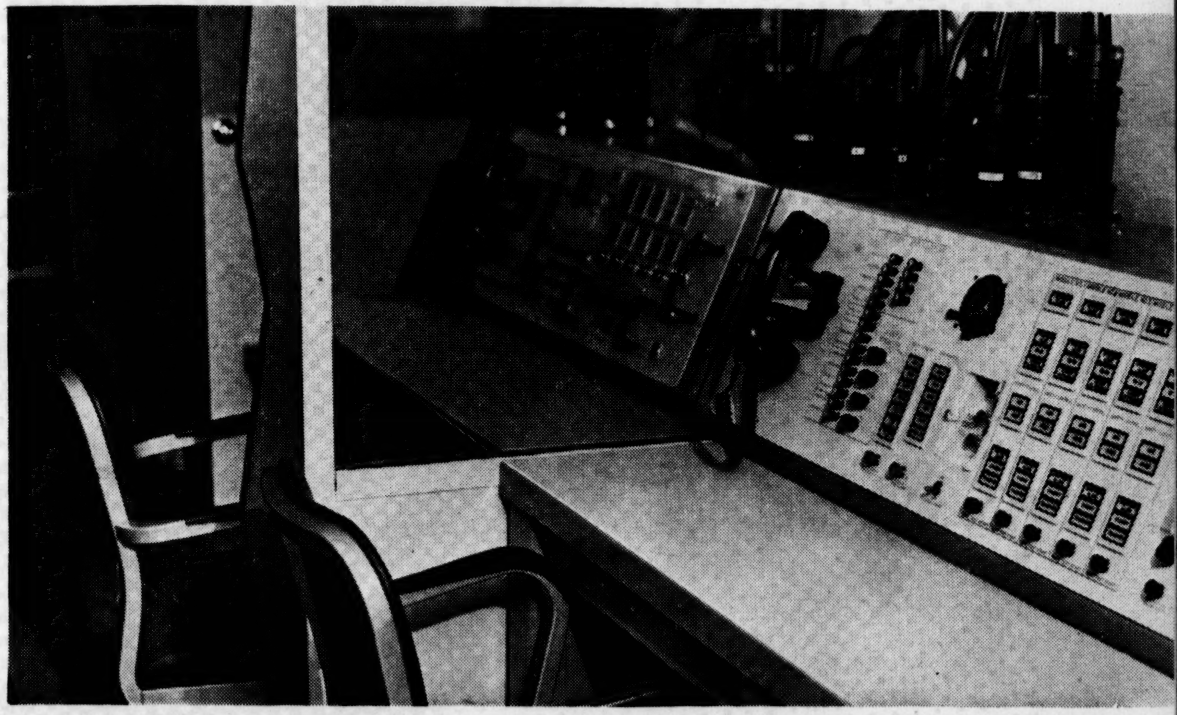
Hamilton Standard has achieved success in a 100-hr. test of a system designed to remove carbon dioxide from the air inside space capsules. The system, under development for 2½ years, processes air through canisters that contain tiny regenerable crystals of sodium alumino silicate. These crystals have pores 15 to 20 billionths of an inch in diameter which absorb the carbon dioxide molecules.

In the recent tests, two engineers were closed inside an airtight chamber and carbon dioxide was fed into the chamber to simulate the respiratory output of a third person. At regular intervals, the CO_2 collected by the canisters was evacuated by a vacuum pump which simulated the vacuum of space. In this way more than 300 cu. ft. of carbon dioxide, weighing about 36 lb., were evacuated during the 100-hr. test.



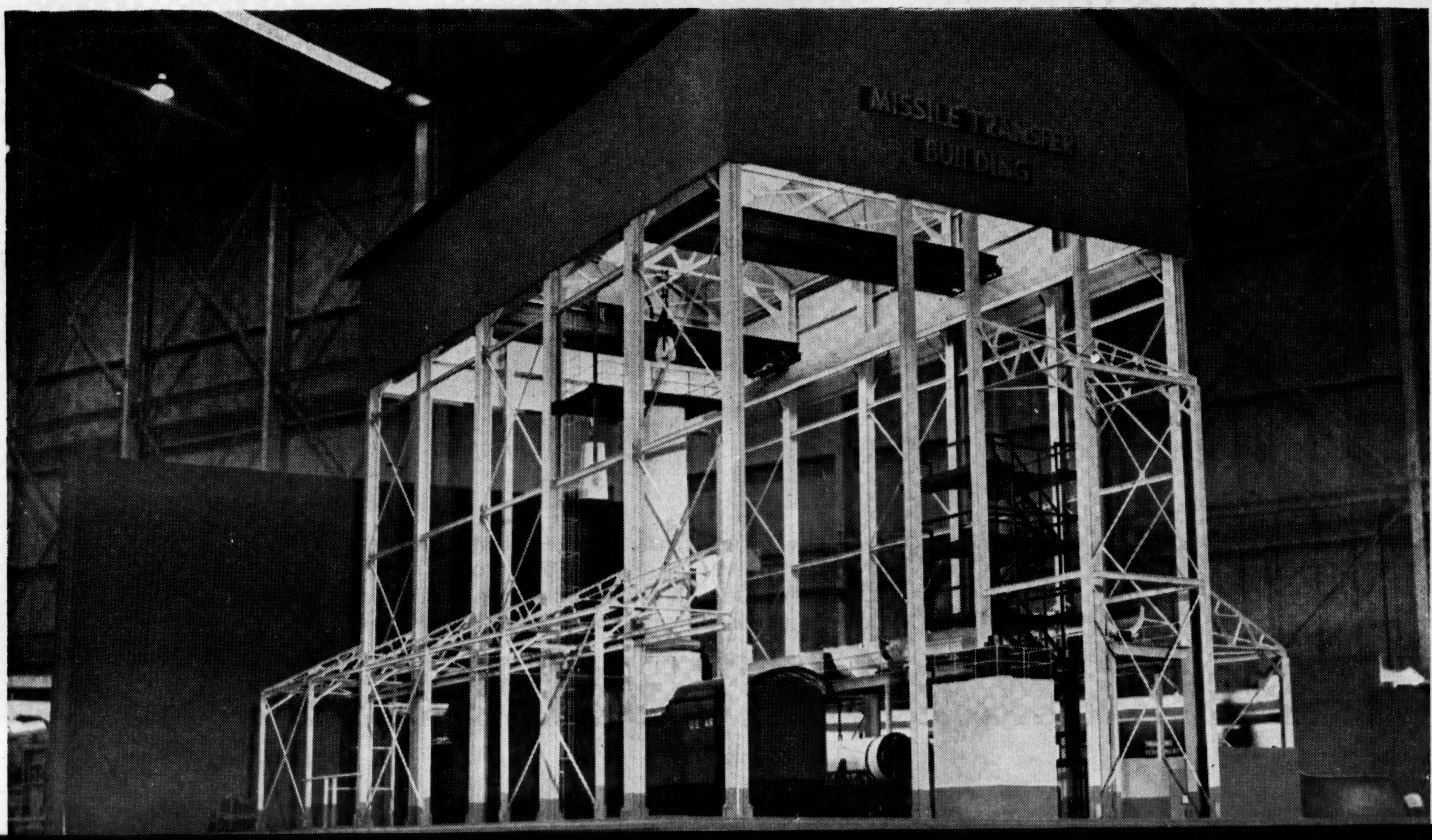
Mockup of a complete mobile unit support base (MUSB), part of which is shown above, was made by Boeing Airplane Co. for a recent developmental engineering inspection held in Seattle, Wash. Service, maintenance and resupply will be performed here on the Minuteman trains between the two-week "cruises" they will make over the nation's 200,000 mi. of roadbed. First MUSB will be constructed near Hill AFB, Utah.

Minuteman Mobile Unit Support Base Model Shown

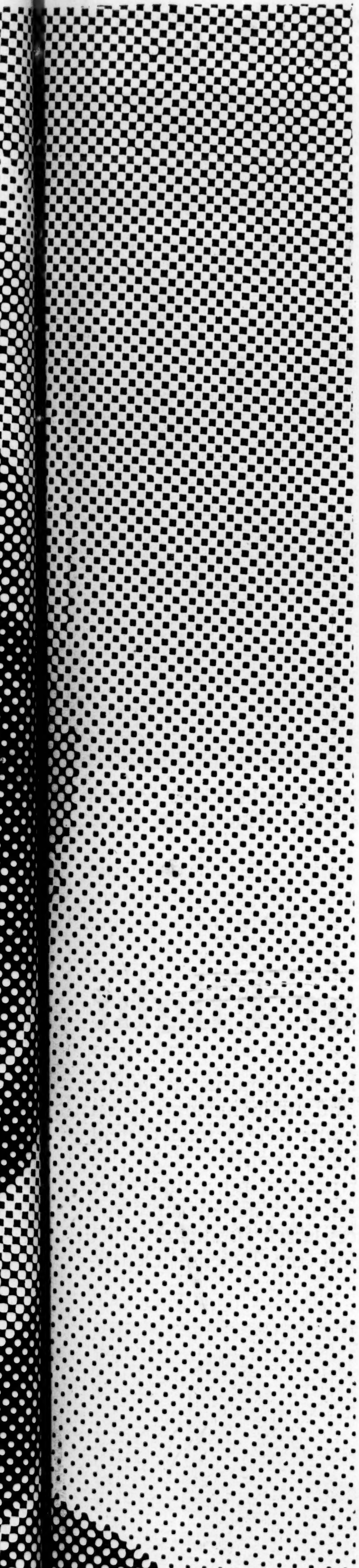


Launch control car of the mobile Minuteman train is equipped with two identical launch consoles in series, shown here in the developmental engineering inspection (DEI) mockup. Consoles have five positions for each of the missiles carried on the train. Consoles will be separated by bullet-proof glass, and will be entered through separate, locked doors. Sequences on both consoles must be completed before a missile can be fired, thereby preventing inadvertent firing by one man.

Missile transfer building, shown below in model form, will be built to accommodate missile carriers in the mobile unit support base (MUSB). Here Minuteman missiles will be placed within strongbacks, nuclear warheads will be installed, and the combat-ready ICBMs will be loaded aboard rail cars.



The most proven large ballistic missiles, the Atlas (left) and Redstone (right), will launch America's Astronauts. Main-stage engines of both are by Rocketdyne.



AMERICA'S ASTRONAUTS WILL BE LAUNCHED INTO SPACE BY ROCKETDYNE ENGINES

America's man-in-space programs demand the ultimate in reliability. There is no room for error—that is why America's most experienced rocket engines have been chosen for the job.

And this means engines built by Rocketdyne.

A Redstone engine, whose performance over a decade of development includes 62 consecutive successful flights, will loft the first manned space craft high over the Atlantic in an exploratory ballistic arc.

Then an Atlas system of five engines, proven in more than 60 development and operational flights, will send a man soaring upward more than 100 miles to circle earth for four hours during man's first orbital flight in space.

To that dramatic moment, Redstone and Atlas will carry the heritage of more than 18,500 large engine tests at Rocketdyne's Propulsion Field Laboratory.

At every level of operation—from engineering to manufacturing to cost control—Rocketdyne has pioneered new concepts. Advanced management programs, combined with vast experience and the foremost high-thrust test facilities in the nation, give Rocketdyne the capability today to meet the challenges of tomorrow.

Rocketdyne engines have launched more than 250 missiles, satellites, and space probes.

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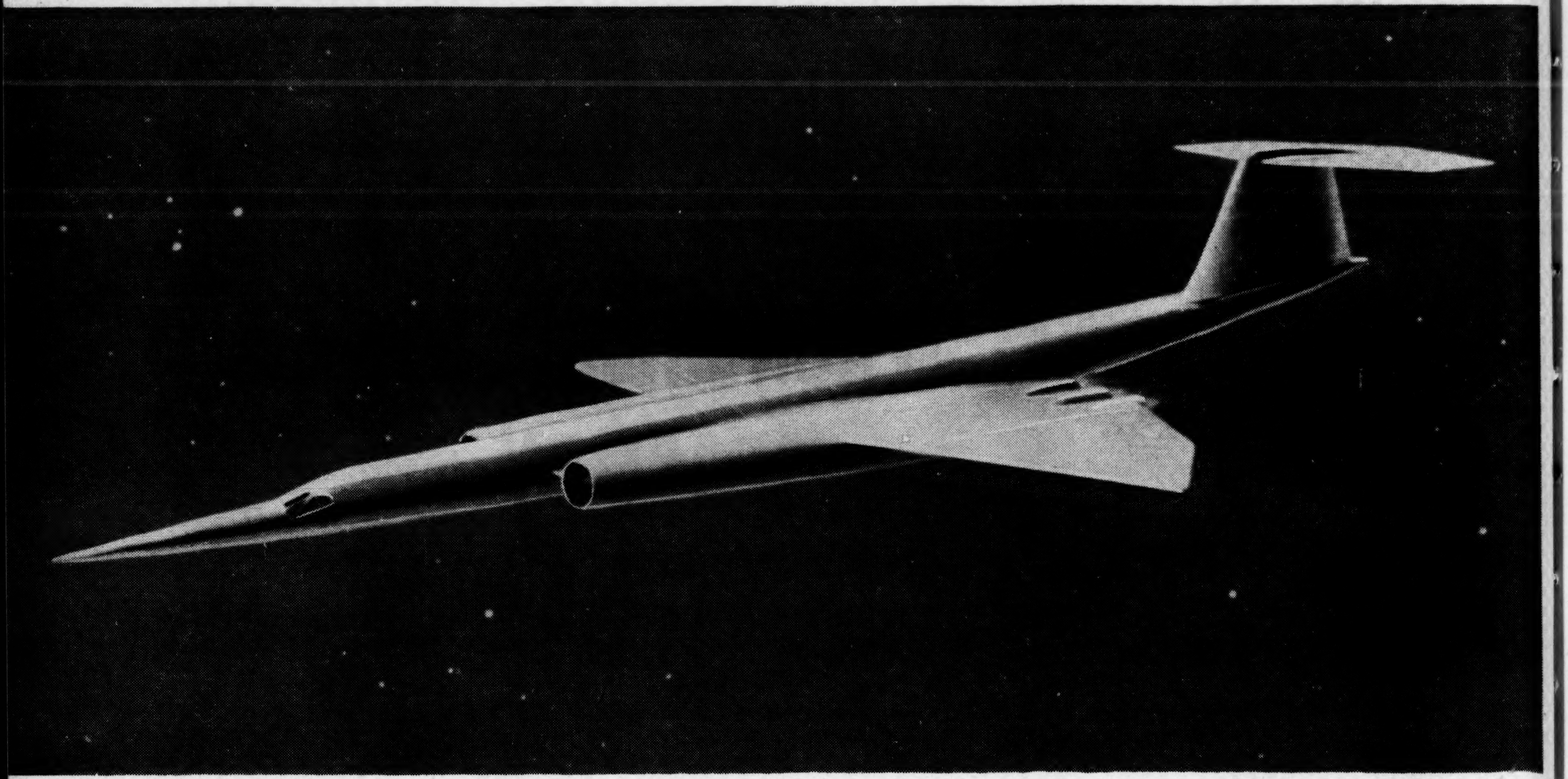
AERONAUTICAL ENGINEERING



NUCLEAR-POWERED attack aircraft considered by the Air Force in 1955 is shown above. This Lockheed design was to have been powered by six Pratt & Whitney indirect cycle J91 nuclear turbojet engines operating from two circulating-fuel reactors. This aircraft would have had supersonic dash capability when engine power was augmented by burning chemical fuel.

Special Report:

Gains Promise Supersonic Nuclear Flight

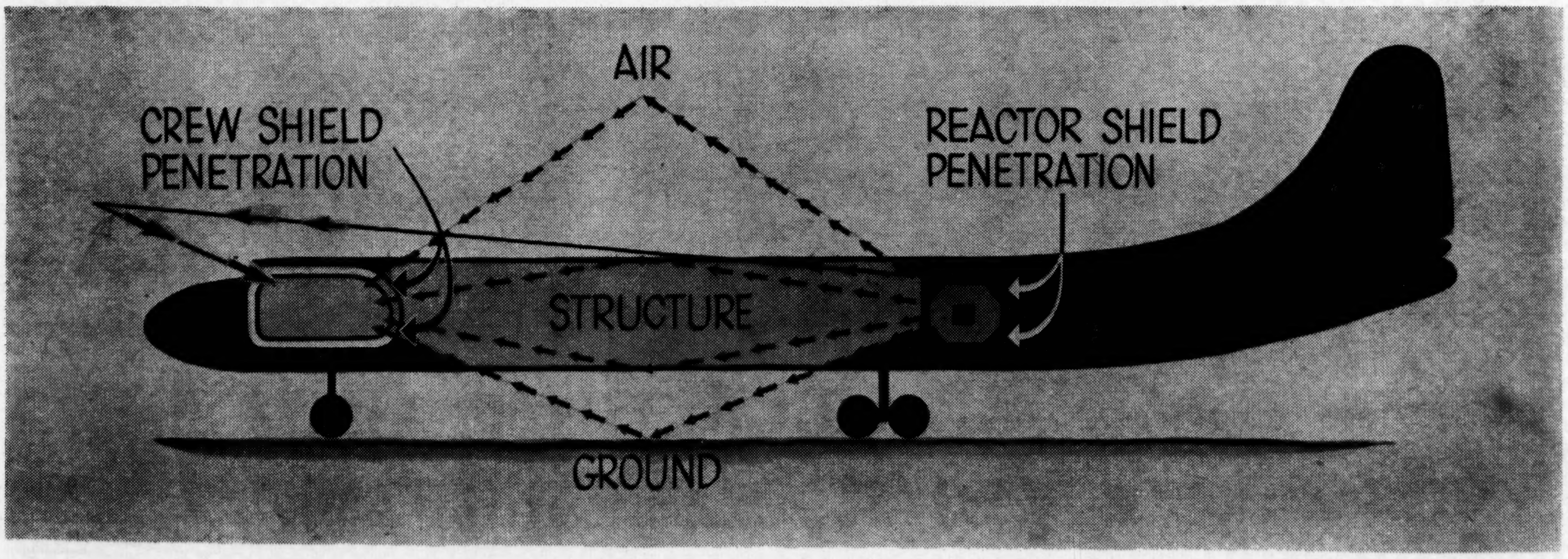
This is the third of a series of articles on the various applications of nuclear power to aircraft and space vehicles.

Washington—Recent advances in supersonic aerodynamics and engine technology may make it possible to operate a nuclear aircraft at supersonic speeds, powered by reactors based on current technology.

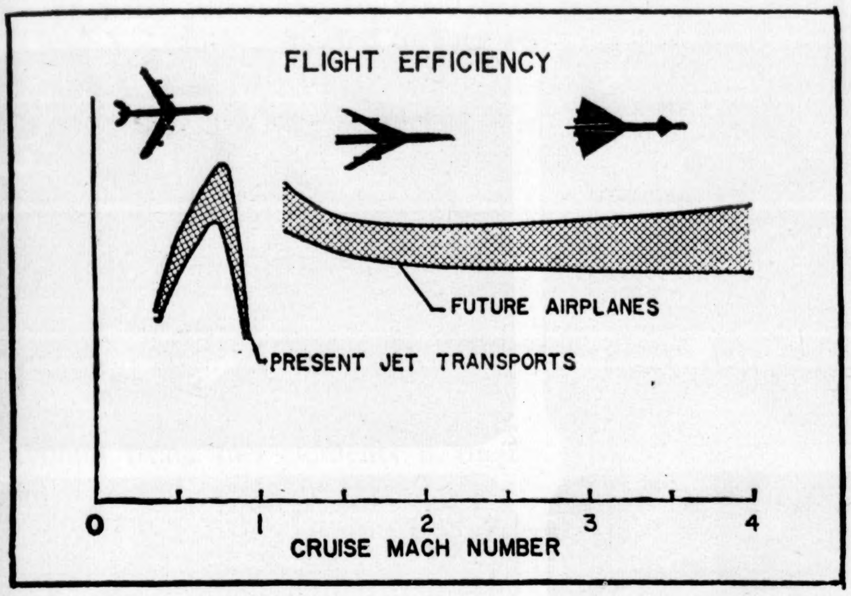
Supersonic Flight

These advances may make nuclear-powered supersonic flight possible without waiting for the development of reactors capable of operating at higher temperatures and producing more power for a given engine weight than current reactor technology permits.

With their promise for a supersonic weapon system, these aerodynamic and engine advances largely invalidate earlier criticism within the Defense Depart-



CREW compartment on a nuclear-powered aircraft using divided shielding must be completely enclosed by its shield to protect the crew from direct radiation from reactor and from radiation scattered by the air, the ground and the aircraft structure.


FLIGHT EFFICIENCY
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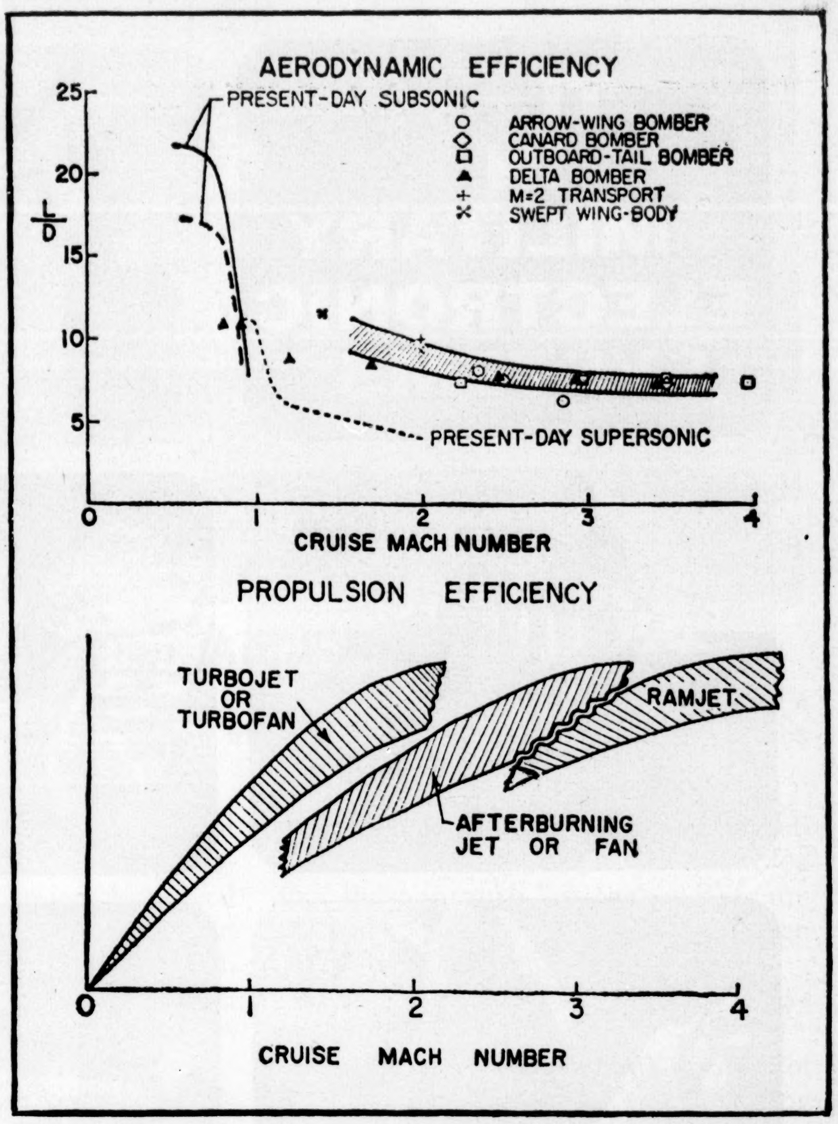
AERODYNAMIC EFFICIENCY
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◇ CANARD BOMBER
□ OUTBOARD-TAIL BOMBER
▲ DELTA BOMBER
+ M=2 TRANSPORT
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PRESENT-DAY SUPERSONIC
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PROPULSION EFFICIENCY
TURBOJET OR TURBOFAN
RAMJET
AFTERBURNING JET OR FAN
0
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CRUISE MACH NUMBER

THREE charts illustrate how improvements in aerodynamic and propulsive efficiency during the last few years have brought the supersonic nuclear-powered aircraft closer to reality. Aerodynamic efficiency of supersonic aircraft has doubled and turbofan technology has widened the band of propulsive efficiencies which are possible above Mach 1. Total result has been that the flight efficiency of modern supersonic aircraft is very close to that of subsonic jet transports and bombers. A supersonic nuclear aircraft, therefore, will require a much lower power output from its engines than was thought possible a few years ago. Lift/drag ratio for supersonic cruise has been doubled from a figure of four to about eight during the past four years, a performance improvement which made the B-70 program possible.

ment that nuclear-powered aircraft based on current technology must be subsonic and therefore would have limited military value. They are:

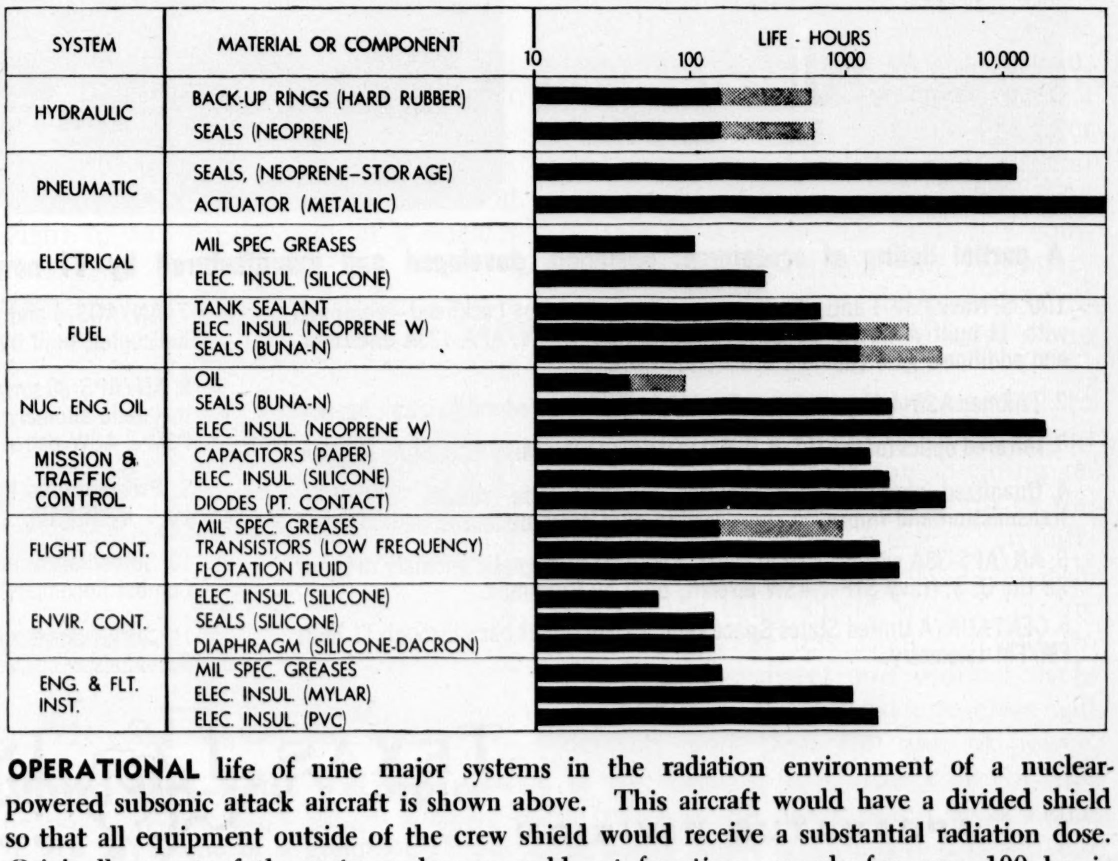
- **Improved lift/drag ratios.** In the past four years, the lift/drag ratio for supersonic cruise has been doubled from a figure of four to about eight. This performance improvement made the B-70 possible, and it also serves to cut the previously estimated power requirement for nuclear-powered supersonic aircraft in half.
- **Improved second-generation** ducted fan engine technology. Development of turbofan engines has reached an advanced state in the past three years. The very high propulsive efficiency of these engines makes it possible to increase the thrust developed by any given heat source, nuclear or chemical, at both subsonic and supersonic speeds.

Total effect of these two developments has been to lower the thrust-to-weight ratio required for supersonic flight to the point where the aircraft reactors being developed by General Electric and Pratt & Whitney Aircraft may be considered for this purpose.

Convair Testbed

The currently active nuclear aircraft project, the Convair NX-2 subsonic testbed scheduled for first flight in 1965, is essentially the same design with which the company won the Camal competition in March, 1959. The Camal aircraft was to provide the Air Force with continuous airborne alert, missile launching and low-level penetration ability over unlimited ranges with target approach from any direction.

The NX-2 is to serve as a testbed for nuclear engines, radiation resistant aircraft systems, flight and ground handling procedures and all phases of nuclear aircraft operation so detailed specifications can be written for a weapon system. Basic specifications for the experimental NX-2 call for a speed of Mach 0.8 to 0.9 at 35,000 ft., length of about 150 ft., span of approximately 180 ft., gross weight in the neighborhood of 500,000 lb., or about B-52 size, and a mission endurance for the aircraft and all its systems of 120 hr. Such major systems as the engines are



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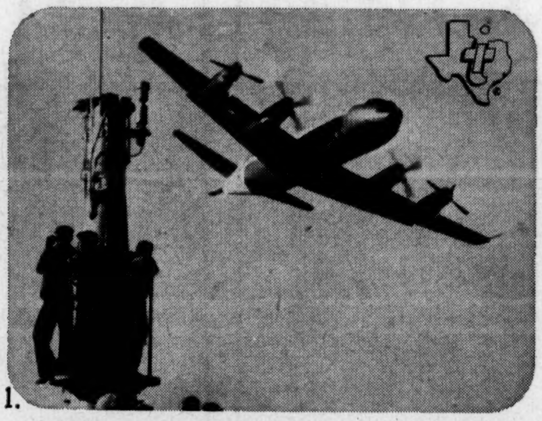

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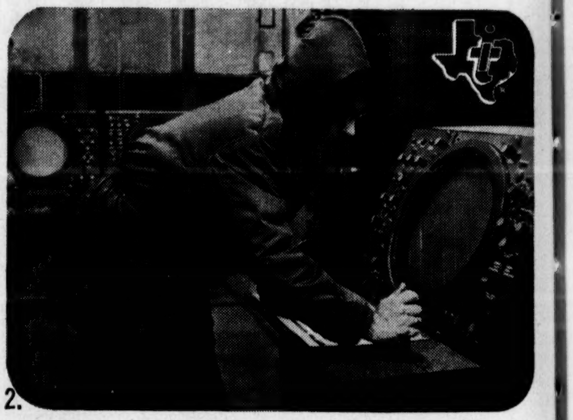

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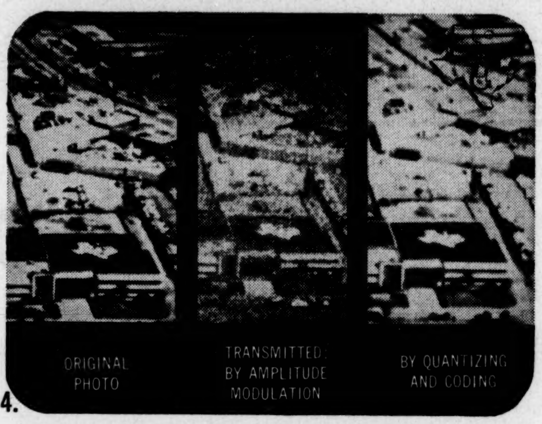

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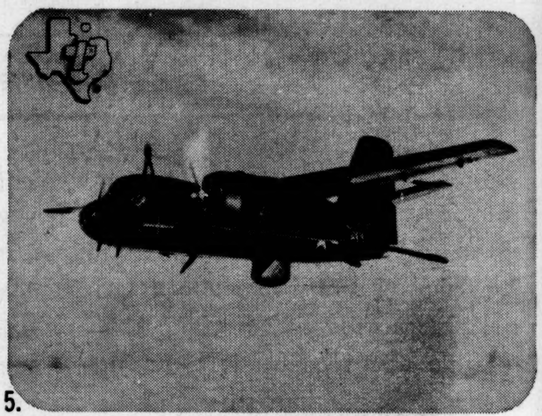

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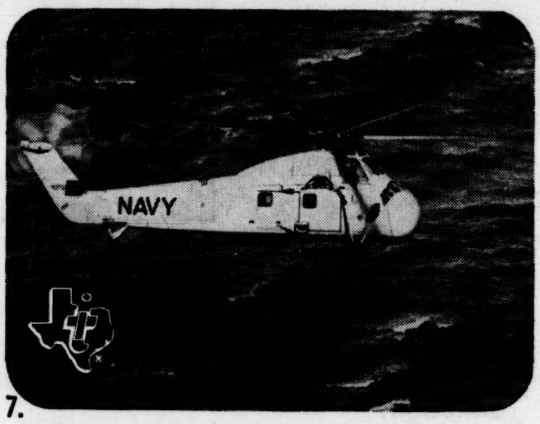

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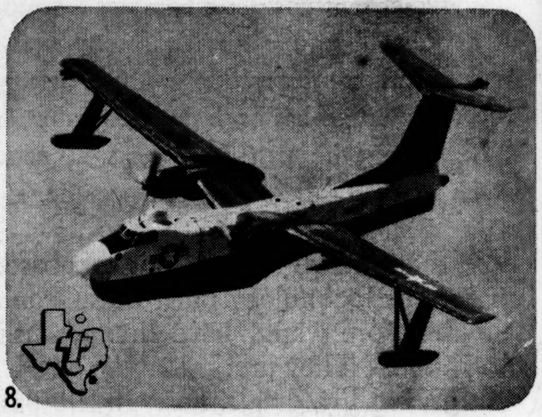

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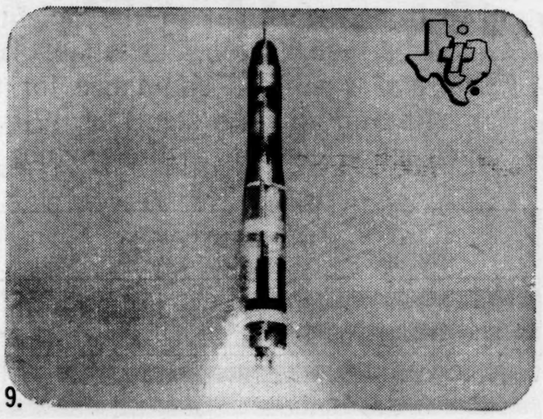

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A partial listing of equipment, designed, developed and manufactured by TI now operational in the Armed Forces includes:

1. U. S. Navy P3V-1 antisubmarine aircraft produced by Lockheed—equipped with TI-built AN/APS-80 surface search radar, AN/APA-125A indicator, and additional gear (nomenclature classified).
2. TARmac ASR-4 Airport Surveillance Radar for the Federal Aviation Agency.
3. Infrared optics for the U.S.A.F. FALCON Air-to-Air Missile, built by Hughes.
4. Quantized photograph, transmitted by PCM code, results in faithful transmission and improved reproduction over great distances.
5. AN/APS-38A surface search radar, AN/ASQ-8 magnetic anomaly detector for the U. S. Navy S2F-1 ASW aircraft, built by Grumman.
6. CENTAUR (A United States Space Vehicle) will report back through TI-built FM/FM telemetry.
7. AN/AQS-4 and AN/AQS-5 dipping sonar for the U. S. Navy HSS-1N ASW helicopter, built by Sikorsky.
8. AN/APS-80 surface search radar, AN/APA-125A radar indicator, AN/ASQ-8 magnetic anomaly detector and TD-239A intervalometer for the U. S. Navy P5M-2 ASW patrol seaplane, produced by Martin.
9. Programmers for the U.S.A.F. TITAN Intercontinental Ballistic Missile, built by Martin.
10. Surveillance sensors for the U.S. Army Signal Corps SWALLOW AN/USD-4 Combat Reconnaissance Drone, produced by Republic Aviation.
11. Surveillance sensors for the U. S. Army Signal Corps AN/USD-5 Combat Reconnaissance Drone, produced by Fairchild.

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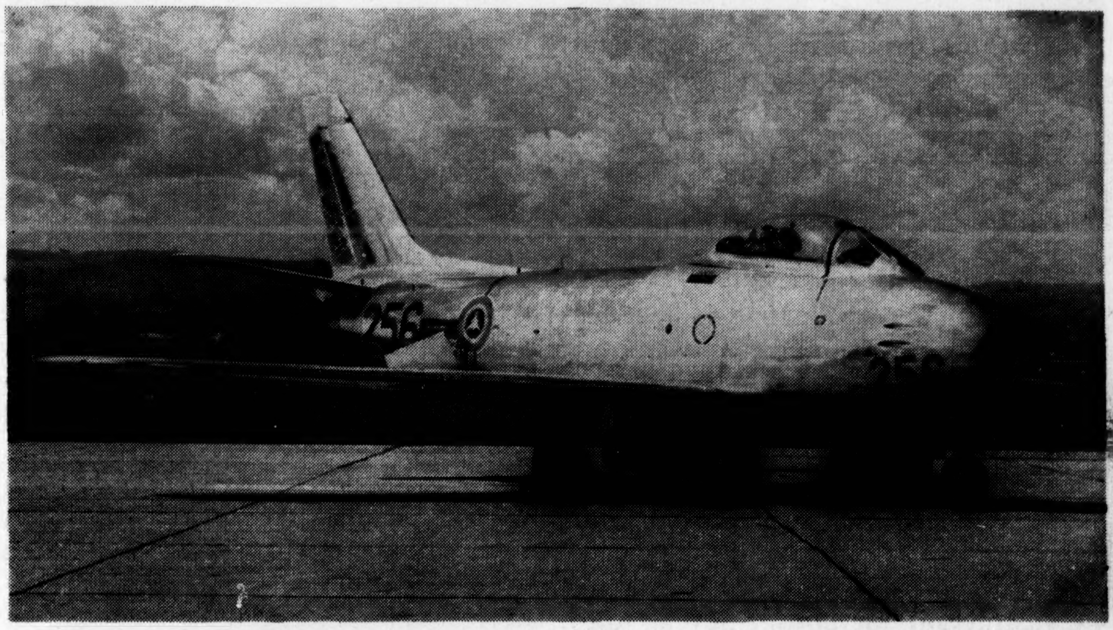


Ethiopian Air Force F-86

Ethiopian air force F-86 above is one of 12 delivered to Ethiopia last July. Trained by a special MAAG group in Ethiopia, the air force played a major role in putting down the recent rebellion. Air force also has several T-33s and about seven C-47s.

to have a life amounting to 1,000 hr.

The NX-2 can be expected to have a payload-carrying ability of 50,000 lb. or better if performance currently predicted for flightweight nuclear engines can be achieved. There is every indication now that these predictions can be equaled or bettered. The reactor test work on the direct cycle engine has been encouraging, producing a reactor exit air temperature of 1,600F using metal fuel elements. It is possible to achieve much higher temperatures with beryllium oxide fuel elements if their endurance and radiation problems can be overcome.

Early estimates of nuclear aircraft performance by the National Advisory Committee for Aeronautics showed that reactor exhaust temperature of 1,600F would be more than adequate for an aircraft in the NX-2 weight class if the proper engine thrust-to-weight ratio were attained. Precise data on engine thrust-to-weight ratios are still secret, since they are a key to the performance of any nuclear aircraft and they also indicate the performance growth that can be expected from follow-on aircraft.

NX-2 Thrust-to-Weight Ratio

In broad terms however, the over-all powerplant thrust-to-weight ratio expected on the NX-2 apparently is very good by chemical engine standards. Total powerplant weight on the NX-2 with either the direct or indirect cycle engines installed will be less than 50% of the total weight of the aircraft. This includes the complete shielding system, reactors and engines.

On big chemically fueled aircraft such as the B-52, the fuel weight runs approximately 50% of the takeoff gross weight, and the engines amount to another 8% or so.

On the basis of this information, the NX-2 will have an aircraft thrust-to-weight ratio that is better than the B-52 at takeoff. This comparison shows that the NX-2 is not only feasible, as is now conceded by all technical authorities in the field, but apparently it will also have a good payload capacity. Payload capacity can be traded for speed improvement, especially if a follow-on nuclear system is mated with an advanced turbofan engine and with a state-of-the-art supersonic airframe offering a high lift/drag ratio.

Primary consideration in the layout of the NX-2 configuration was to keep the shielding weight as low as possible. This probably will be the overriding design aim for all nuclear-powered aircraft. Shield weight is expected to be about 20% of the total NX-2 weight with an indirect cycle engine, and around 25% with the direct cycle.

Shield Design Improved

Shield design skills have improved dramatically during the ANP program, and it has been several years since the shield weight requirement was reduced below the point where it was so high that it made the nuclear aircraft impractical. Originally, there was about a 50% uncertainty in the estimated shield weight in any paper study of a nuclear aircraft. As a result of the extensive effort on this problem, it is now believed that there is much less than a 10% uncertainty in any preliminary design shield weight estimate.

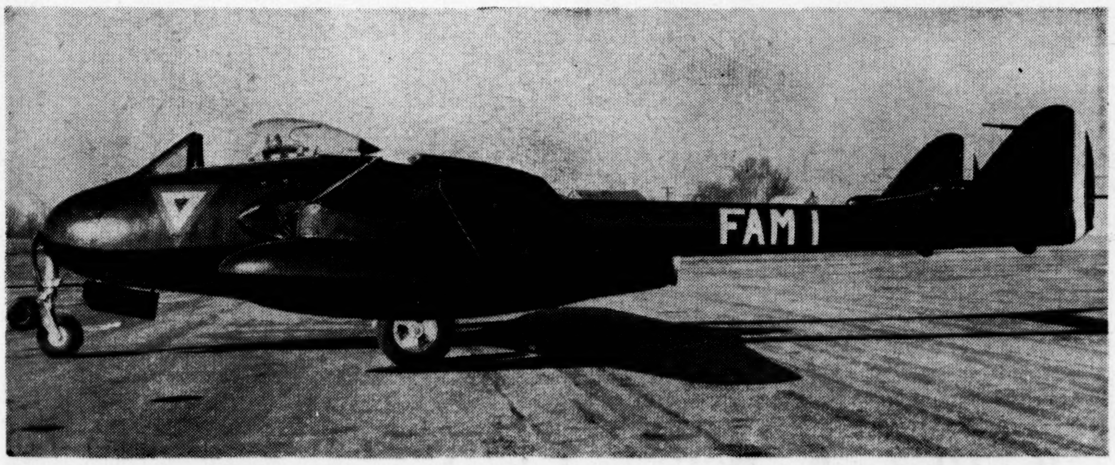
This opinion is backed by extensive experimental data.

No further improvements of a major nature are expected in shield design. Systematic studies have been made of every conceivable shielding material, and nuclear scientists report that there will be no shielding breakthrough unless there is some revolutionary discovery in basic physics regarding the relationship between energy and matter.

Best way to show what has been accomplished with aircraft shielding is to compare the NX-2 shield weight with that required by a ground-based reactor of about the same size as the NX-2 unit. If power output is assumed to be 100 mw. for the sake of comparison, the ground-based reactor would need a shield more than 20 ft. in diameter weighing about 1 million lb. Radiation level on the outside of this shield would be safe for humans. Concrete is a common shielding material for stationery reactors because it is cheap and effective, and its weight and bulk are of no importance.

Since it was entirely impractical to think of flying a shield of this size and weight, the success of the shielding research programs was a key factor in the practicality of the nuclear aircraft. Through these programs, it was possible to get the total shield weight on the NX-2 down to less than 150,000 lb. For both the direct and indirect cycle engines, even though their reactors will develop more than 100 mw. of power. With these shields, the crew of the NX-2 will not be exposed to a radiation dose any larger than that permitted for AEC employes.

The nuclear engineer has four major



Mexican Air Force de Havilland DH-100 Vampire

Mexican air force de Havilland DH-100 Vampire Mk. III is one of a group of 15 purchased as surplus from the Royal Canadian Air Force. Aircraft will form Mexico's first jet fighter squadron; are being overhauled by Fliteways, Inc., West Bend, Wis.

tools at his command to keep shield weight down. The objective of shielding research has been to increase the understanding of these four tools so they may be applied to the best advantage.

They are:

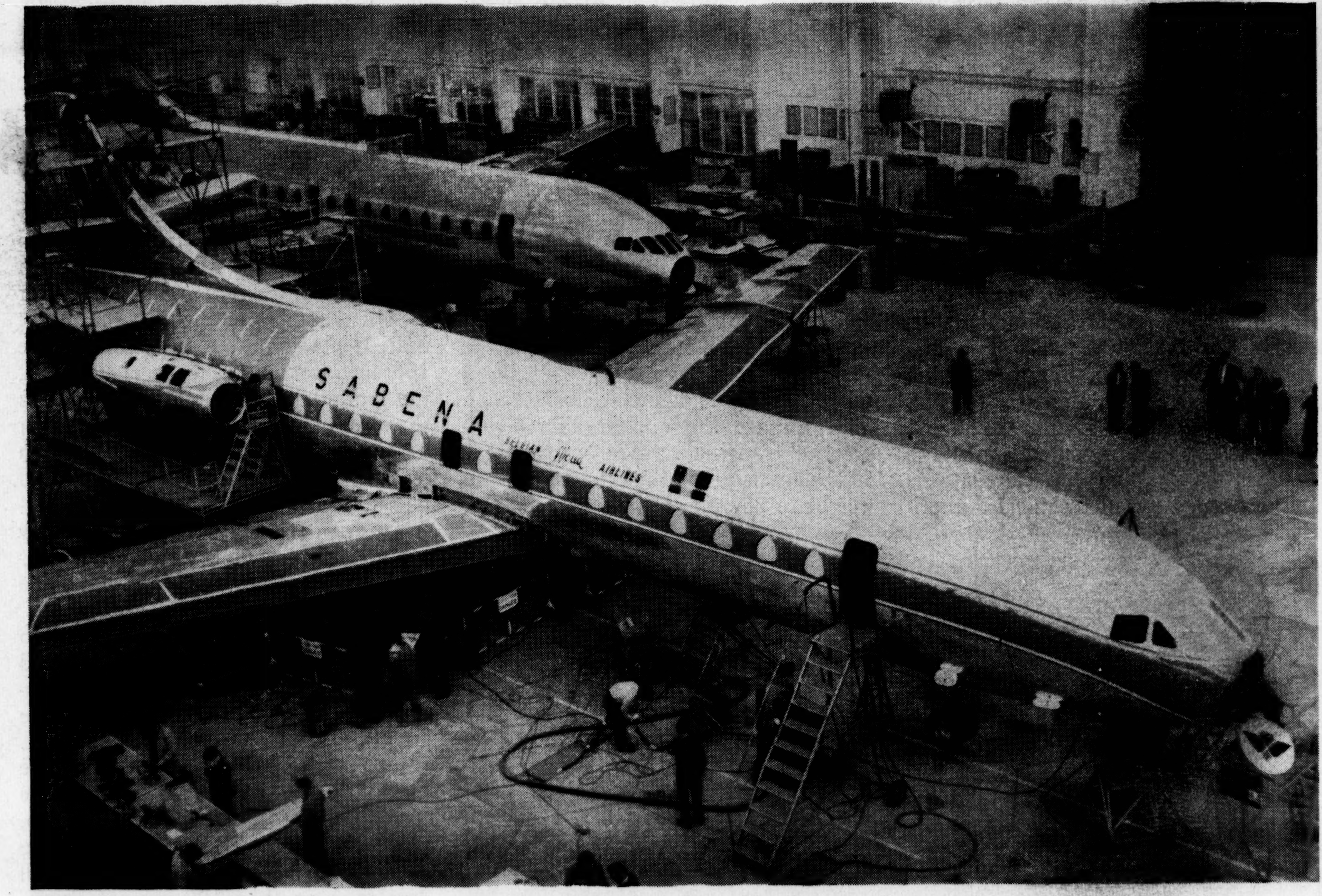
- **Distribution of shield mass.** Decision must be made whether the shield weight should be concentrated around the reactor, around the crew and equipment which must be protected, or distributed in all of these areas.
- **Selection of materials.** Materials must be used which will absorb the maximum possible radiation energy for a given weight of shield.
- **Construction methods.** Several different materials are usually required in lightweight shields, and they can be used as a homogeneous mixture or in separate layers.
- **Geometry.** Radiation pattern from an aircraft reactor is distorted by the heavy structure, engines and equipment which are near the reactor by an unequal distribution of the shielding mass and by asymetrical reactor geometry. Distortion also takes place because radiation is scattered by the air during flight and by the air and the ground during takeoff and landing. It is possible to save weight if the heaviest portions of the shield can be placed in the path of the heaviest radiation.

Most effective means of reducing shield weight is through distribution. There are two general classifications of shields, as determined by the distribution of their mass. They are:

- **Unit shields,** in which the entire shield mass is concentrated around the reactor. With this design, the radiation on the outside of the shield is reduced to a safe level for humans. The crew and the passengers of an aircraft using the unit shield could move about at will during flight, and the aircraft could be serviced immediately upon landing. Disadvantage of the unit shield is that it is extremely large and heavy, although its size and weight can be reduced well below those of unit shields currently used with ground-based reactors. With current technology, unit shields probably will be practical only for aircraft with indirect cycle engines and very low power requirements. Early warning aircraft and 400 mph. transports using turboprops fit this category. If the unit shields do prove practical for such aircraft, very careful design work will be required to make them work.
- **Divided shields,** in which part of the shield mass is placed around the reactor and part around the crew compartment. Shield weight can be lowered dramatically by using a divided rather than a unit shield. Divided shielding will be used on the NX-2 and undoubtedly will be needed on any high performance attack aircraft that might materialize at a later date. Most favorable distribution appears to be about half of the shield weight around the reactor and half around the crew compartment.

Divided shielding means that there will be two vastly different radiation levels on the aircraft, a very low one inside the crew compartment and a very high one outside. This is acceptable because humans are about a thousand times more susceptible to radiation than most materials in aircraft structure and equipment.

Penalties for divided shielding are: confining the crew to a relatively small, cramped compartment for several days at a time; laborious, time-consuming remote handling maintenance of engines and equipment; exposing most of the aircraft structure and its systems to high energy radiation, which sharply reduces their useful life. Although



Sabena Caravelle VI to Be Delivered in January

First Sabena Caravelle VI is in final assembly at Sud Aviation's Toulouse factory. Sabena originally ordered four Caravelle VIs, then increased its order to six. The first is expected to be delivered in January, the last two in June. The Caravelle VI will have two Rolls-Royce Ra.29 Mk. 6 turbojets rated at 12,200 lb. thrust. These engines increase maximum takeoff weight to 103,617 lb. from 99,208 lb. for the Caravelle III, which is powered by earlier Ra.29 Avons rated at about 11,400 lb. thrust.

these are serious penalties, they are outweighed by the relatively light weight of the divided shield.

In the most basic terms, it is easy to explain the processes by which matter can attenuate and absorb the radiation energy from a nuclear reactor. The easy elementary explanation, however, does not properly reflect the difficulty of the research which led to the present advanced state of shield technology and materials. Detailed study of the actions and interactions between radiation energy and the atoms in the shields has proven extremely complicated, and it has involved endless experiments and computer work.

Two Types

Basically, there are two types of radiation from a fission reactor which must be shielded to protect humans and aircraft equipment. They are neutrons and gamma rays. The basic processes by which they are slowed down and absorbed are:

- **Neutrons are slowed down** through a series of elastic or billiard-ball collisions with atomic nuclei. The lighter the nuclei that the neutrons strike, the more energy they lose per collision. The slowing down or moderating process is vital to neutron shielding because neutrons generally are absorbed into one of the atoms in the shield more readily when they have low energy. Practically, this means that the best materials for neutron shielding have a high proportion of atoms with a low atomic number and light nuclei. Hydrogen is best in this respect, and water or any material that contains a high percentage of hydrogen is a good neutron shield.
- **Gamma rays lose** their strength through collisions with electrons. Therefore, a gamma ray shield should have a maximum number of electrons, which makes the dense elements with high atomic numbers most attractive. Lead, iron, tungsten and tantalum are good gamma shields.

Shield materials cannot be selected on the basis of their nuclear properties alone, because about 90% of the energy released by a fission reactor is thermal. Shields are subjected to very high heat loads and must be cooled. They are also used to carry airframe loads in some designs so their great weight is not wasted structurally.

To satisfy all of these considerations, the important factors in the selection of shield materials include nuclear properties, weight per cubic foot of material, strength at high temperatures, cooling required, and thermal stability and resistance to oxidation at high temperatures.

Heavy metal hydrides would be an ideal shielding material except for one major fault. These substances will stop both gamma rays and neutrons efficiently because they contain many electrons as well as hydrogen nuclei. Unfortunately, their thermal stability is poor, they oxidize readily in air at high temperatures, and it has been difficult to apply an efficient protective coating to them.

New Materials Developed

New materials, developed for shielding use, have primarily been plastics which have large percentages of light nuclei and exhibit the proper thermal and strength characteristics.

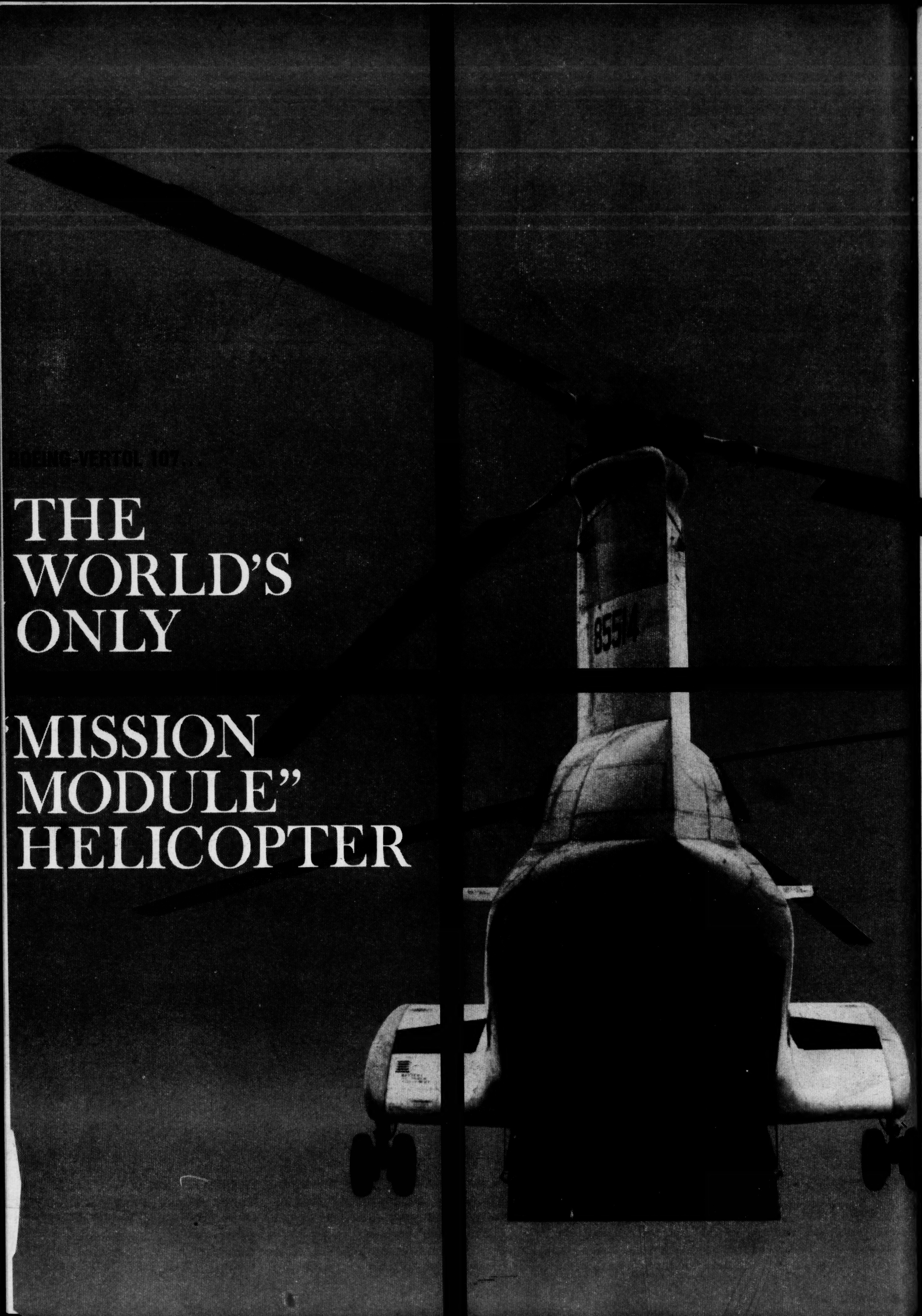
Lightweight shields are usually constructed of several materials, each of which is the optimum for stopping or slowing radiation of a given energy level. For examples, some light materials will slow or moderate fast neutrons very efficiently, while they have an inferior capacity for absorbing and stopping slow neutrons. Other light shielding materials have exactly the opposite properties and will absorb slow neutrons well, but are poor moderators. Each type of heavy gamma ray shielding also will perform best in stopping gammas of a particular energy level.

It is possible to use homogeneous shields in which the necessary materials are mixed together evenly. This has not proved to be the lightest construction method in most cases, however, and it has been more efficient to use several materials arranged in separate layers or slabs.

Layered shield design can be beneficial from the nuclear standpoint because each layer can be specifically chosen to attenuate the secondary radiation emitted from the inner shields as well as a portion of the radiation from the reactor. Control of the secondary radiation, released as gamma rays and neutrons bounce around among the atoms of the shield material, is as important as control of the primary radiation from the reactor. It is possible with improper shield design for the sec-

Tunisian Air Force Saab Safir

First nine of 15 Saab 91D Safir trainer and liaison aircraft ordered by the Tunisian government were recently delivered from Sweden. Safir above is shown in markings of Tunisian air force. Remaining six aircraft on order are scheduled to be delivered early next year.



BOEING-VERTOL 107...

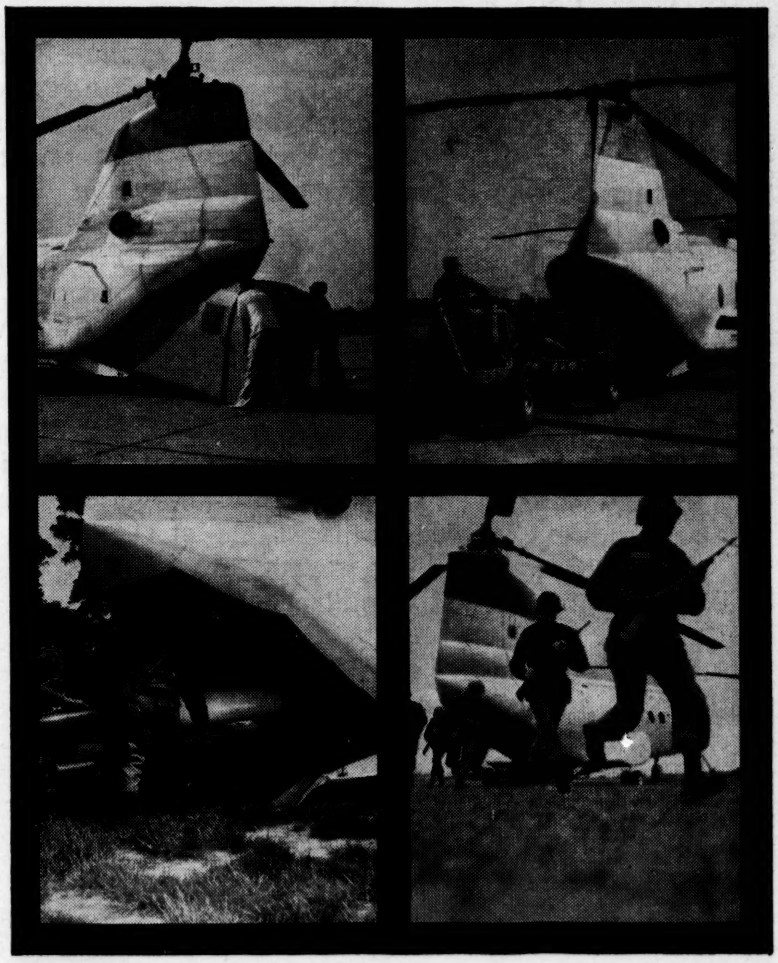
THE WORLD'S ONLY "MISSION MODULE" HELICOPTER

CONVERTS FROM MINESWEEPING TO ASW IN ONE HOUR

The new twin turbine-powered Boeing-Vertol 107 is the only helicopter flying today that can perform so many military missions—without costly conversion of the basic aircraft. The rear loading ramp and unobstructed cargo area permit a variety of modules or equipment to be quickly and easily installed on the 107, thereby enabling it to perform specialized missions for any and all military services. The Navy, for example, can use the Boeing-Vertol 107 for minesweeping and fleet utility duties and then, less than sixty minutes after mission completion, convert to anti-submarine warfare—simply by installing Vertol's ASW module.

Whatever the mission, the performance-proved Boeing-Vertol 107 offers features unmatched by any other helicopter—150 mile-an-hour cruise speed . . . neutral directional stability at zero airspeed for any-wind hovering . . . a Vertol-developed stability augmentation system (SAS) provides fixed-wing aircraft stability which can be augmented with a trim system for automatic flight . . . tandem-rotor design that minimizes down-wash velocities . . . ability to land and take-off from water without special flotation gear.

These are just a few of the capabilities that make the Boeing-Vertol 107 the *first* all-mission, all-service helicopter.



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First Flight-Line Photo of Sikorsky HSS-2s

First flight-line picture of the Sikorsky HSS-2 twin-turbine ASW helicopter now in production for U. S. Navy emphasizes the large, boxy boat hull necessary to contain all the avionic gear basic to the primary mission. Simulated mission profiles, featuring two-hour cruise and two-hour hover, have been flown as part of company-Navy flight test and performance proof program. Gross weight of the HSS-2 is 17,300 lb.; powerplant is a pair of General Electric T58-8 turboprops currently rated at 1,250 shp. each.

ondary radiation to augment certain types of primary radiation and increase the radiation flux striking the outer layers of the shield.

Layering also can produce weight benefits if the heavy gamma ray portions can be placed close to the reactor so their volume is kept to a minimum.

Most experts believe that generalized shield research has reached the point of diminishing returns and that little new information of importance will be gathered on shield materials, layered construction and the distribution of shield mass. The only significant weight reductions are expected through detailed work on specific aircraft designs in which the effects of shield geometry and the aircraft structure are considered simultaneously.

Use of Geometry

Most important and elementary use of geometry in aircraft shielding is to keep the crew and sensitive mechanical systems a maximum distance from the reactor. Radiation rays travel in straight lines, so they spread apart quickly as they leave a radiation source such as a reactor. As a result, a piece of equipment with a cross sectional area of one square foot would receive a far greater radiation dose if it were located five feet from a reactor than if it were located six feet away.

The proper mathematical statement to describe this effect is that radiation flux or energy (number of particles times their velocity striking a square centimeter each second) reaching any given point on the aircraft varies with the inverse square of its distance from the reactor.

According to this inverse square law, the radiation flux at an equipment station 10 ft. from the reactor shield would be 100 times less than the flux 1 ft. from the shield. At a crew compartment 100 ft. from the reactor shield, the flux would be 100 times less than at the equipment station and 10,000 times less than the radiation intensity 1 ft. from the shield.

The divided shield concept is made possible by this geometrical law governing the spreading of radiation rays with distance. There is a limit, however, to its effective use on aircraft. Structural weight of the fuselage increases as the distance between the crew shield and the reactor shield is increased. Finally, a point is reached where less weight is added by increasing shield weight than by lengthening the fuselage to achieve a given reduction in radiation dose for the crew.

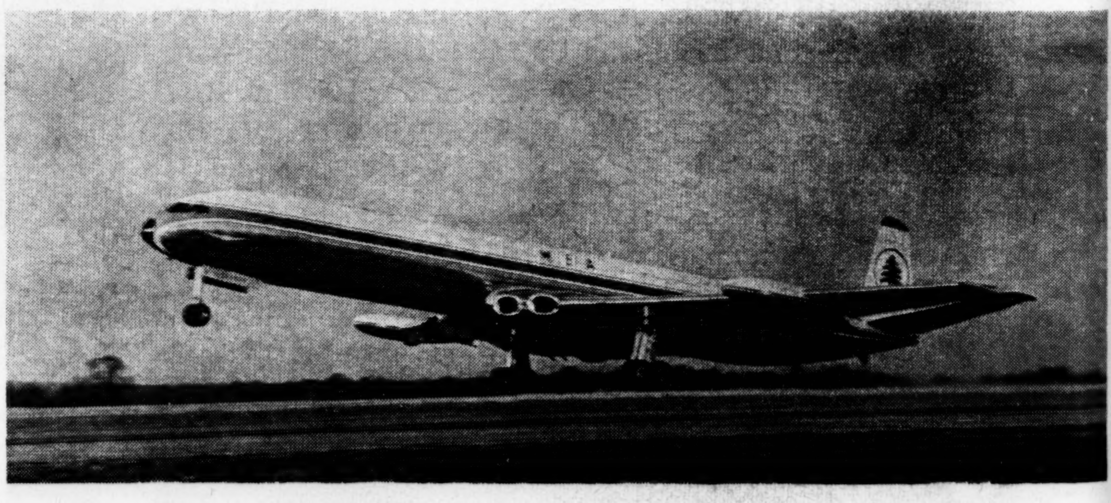
For aluminum aircraft with a fuselage fineness ratio and a reactor power similar to that of the NX-2, the maximum practical distance between the crew compartment and the reactors runs between 100 and 150 ft.

Shadow shielding is another useful device. It consists simply of placing mass near the reactor to provide a cone of reduced radiation extending toward the crew compartment or other areas containing radiation sensitive mechanisms. Shadow shielding may be provided by increasing the thickness of the reactor shield in certain spots or by placing heavy structural components near the reactor so they block off part of the radiation in a specific direction.

It is possible, for example, to locate the wing spars on a sweptwing airplane just ahead of a fuselage-mounted reactor so they will serve as a shadow shield for the crew compartment. Heavy fittings and beams needed to secure the reactor shield to the main aircraft structure are also ideal for use as shadow shields to protect the crew and aircraft systems.

Shadow Shield Requirement

The shield designer must satisfy one main requirement if he is to use shadow shielding and aircraft geometry effectively. He must be able to predict the radiation level at every point of concern by tracing the path of neutrons and gamma rays until they are well clear of the aircraft. While radiation moves in straight lines, it is scattered and its direction altered as it undergoes billiard-



First Middle East Airlines Comet 4C

First of four Comet 4C turbojet transports for Middle East Airlines, powered by four Rolls-Royce Avon engines, made its first flight last month. Aircraft is scheduled to commence regular service for Middle East this month. Other three Comets on order will be delivered in the spring.

Helicopter Winched to Destroyer Deck Landing

Kaman Aircraft Corp. has completed a series of sea tests of a winchdown landing system for destroyer-based helicopters, using a remote-controlled HTK (above) and a safety pilot flying hands-off. Kaman says the system involves use of 400 lb. constant torque strain on a cable attached below the helicopter's center of gravity; aircraft is secure the instant wheels contact the deck. Cable is dropped about 30 ft. above the deck, reeved through a snatch block near the center of the landing pad and then taken up by the constant torque winch which maintains a steady pull; cable strength is about 18,000 lb., or resistant to 2g. Kaman has made the system part of its Harpoon II drone helicopter proposal for U. S. Navy's DASH program (AW May 23, p. 23).

ball type collisions within the shield, aircraft structure, air molecules and the ground. It is possible through these collisions to completely reverse the direction of a significant percentage of the radiation particles. Therefore, the radiation level at each point on the aircraft will vary with the direction under consideration.

Crew Area Penetration

If the crew compartment is considered as an example, the heaviest portion of the radiation follows a straight-line from the reactor shield. Some of it is redirected by single collisions with the structure, the air and the ground if the aircraft is landing or taking off. Another portion of the radiation participates in multiple scattering events. Result of the scattering is that radiation energy strikes the crew compartment from all directions, and it must be shielded on the sides and in front as well as at the rear.

If the crew is to be allowed direct vision forward rather than using periscopes, the windshields in their compartment must be efficient nuclear shields. The rear section of the crew compartment will require by far the thickest shield to stop the heavy straight line radiation as well as scattered particles. The energy of the scattered particles striking the sides, top, bottom and front of the crew compartment is relatively low because radiation strength decreases as the scattering angle increases.

Design and weight of the crew compartment will depend upon how accurately it is possible to predict scattering. A vast number of microscopic and macroscopic studies have been made of the scattering and absorption events which take place when neutrons and gamma rays strike shielding materials, structural materials, the air and the ground. Such studies have established the probability of these two events taking place in the various media and the probable direction the radiation particles will take after scattering.

Originally, there was enough doubt about these laboratory experiments and computer studies that it was felt inadvisable to use them as the sole basis for an aircraft shield design. To eliminate this uncertainty and establish a positive check on its shield design methods, the ANP group conducted a special flight program.

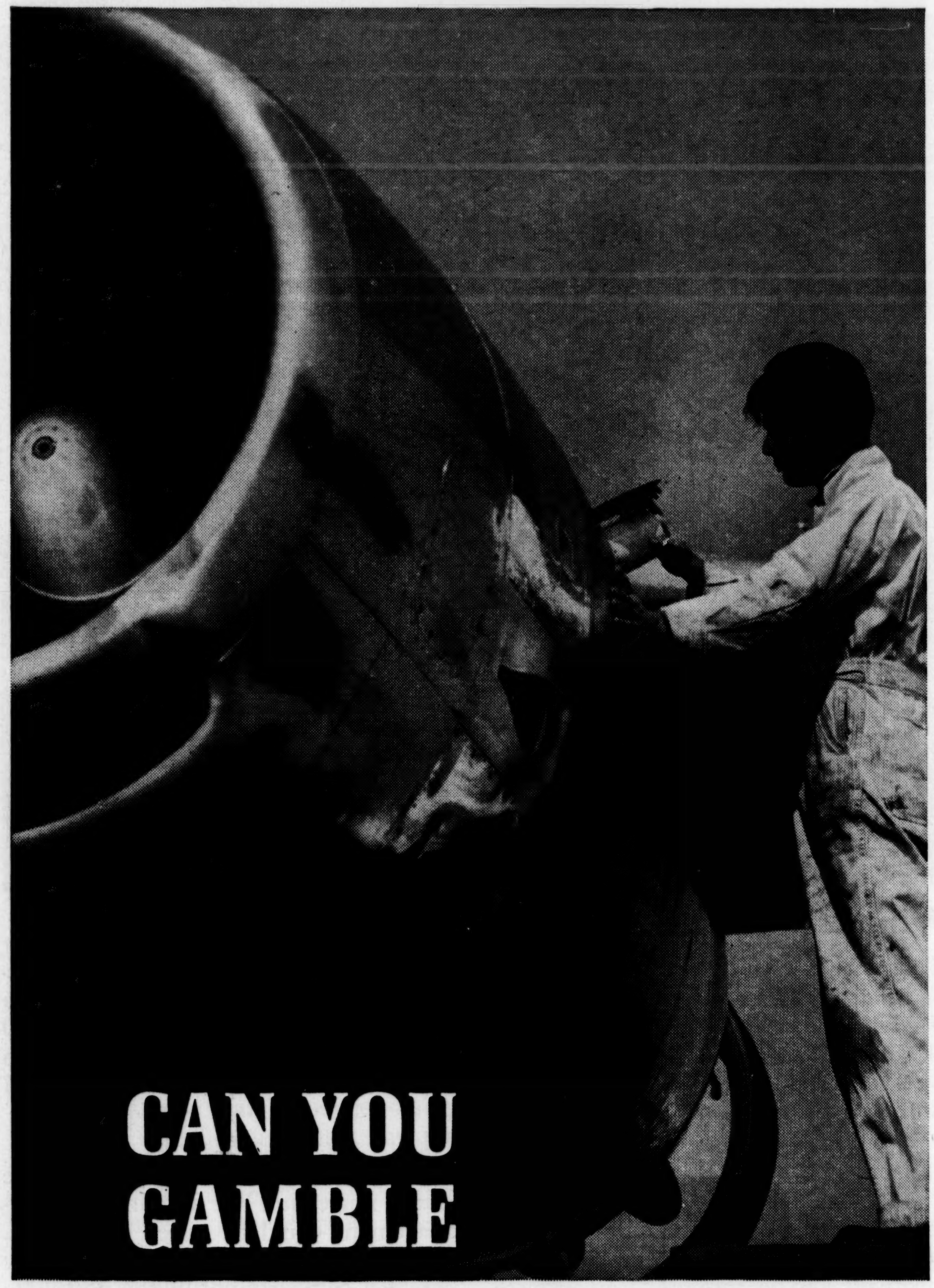
A modified Convair B-36 was used in this program. It had a reactor which could be operated over a fairly wide power range, and the reactor's shield arrangement could be varied extensively. The crew was carried in a heavily shielded compartment in the nose.

Radiation measurements were made in flight and during ground runs so that ground scatter could be differentiated from air and structural scatter. It was also possible to isolate the effects of air scatter from structural radiation scatter by flying the aircraft at high altitudes where atmospheric density was so low that air scatter was negligible.

Static Tests

Static tests concerning air and ground scatter were made with a tower facility at Oak Ridge National Laboratory. This facility allowed test reactors and crew compartments to be suspended with various separation distances and at various heights above the ground. The towers are high enough to allow the ground scatter to be completely eliminated so only air scatter will remain. It would also be possible with this test facility to suspend major aircraft structural components between the reactor and the crew compartment and get structural scatter information.

Good correlation of data from the



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New Technical Bulletin 409B describing azelate-based jet lubes is available by writing Dept. Z-00.

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various ground studies and the flight program showed that it would be possible in the future to use the tower system, small laboratory experiments and computer programs to design and prove the validity of shields for specific aircraft without flight tests. It is expected, however, that it will be possible to refine given shield designs after they are flown.

The shield flight test program with the modified B-36 reached the flight stage in September, 1955, and continued to March, 1957, when all of the test objectives were met and the program was terminated.

One of the most important points regarding detailed shield design is its complexity and the very large number of variables that must be considered. The main objective in many cases is not to achieve minimum shield weight because the maximum thrust-to-weight ratio for a given engine power is effected by inlet air duct design as well as the shield configuration. Pressure drop in the duct must be lowered along with the shield weight or system efficiency does not benefit. ◆◆

Douglas Flies First Turbofan DC-8 Jet

Long Beach, Calif.—First flight of the Series 50 Douglas DC-8 with Pratt & Whitney JT-3D turbofan engines was made recently.

Developing 18,000 lb. of thrust at sea level, the fan engines enable a shorter takeoff run and have better specific fuel consumption at cruise. Series 50 DC-8s have been ordered by KLM Royal Dutch Airlines, Iberia Airlines, Aeronaves de Mexico and United Air Lines. Projected cargo versions also would be powered with the turbofans.

Douglas Aircraft expects the first production aircraft with turbofans to fly within 30 days.

Maximum gross weight of the intercontinental Series 50 will be 315,000 lb. with maximum still air range of 6,000 stat. mi. Domestic Series 50 DC-8s will gross 276,000 lb., have a range of 5,850 stat. mi. Cruise speed of both models will be 585 mph.

Douglas and Boeing Order Eclipse-Pioneer Autopilot

Eclipse-Pioneer Division of The Bendix Corp. has received orders totaling $9.3 million for its transistorized autopilot which is now in use on aircraft of 35 commercial airlines and five military services. The new orders are a $6.4 million contract from the Douglas Aircraft Co. for flight controls for the Navy A4D Skyhawk and a $2.9 million order from Boeing Airplane Co. for systems for the Boeing 707 and 720.

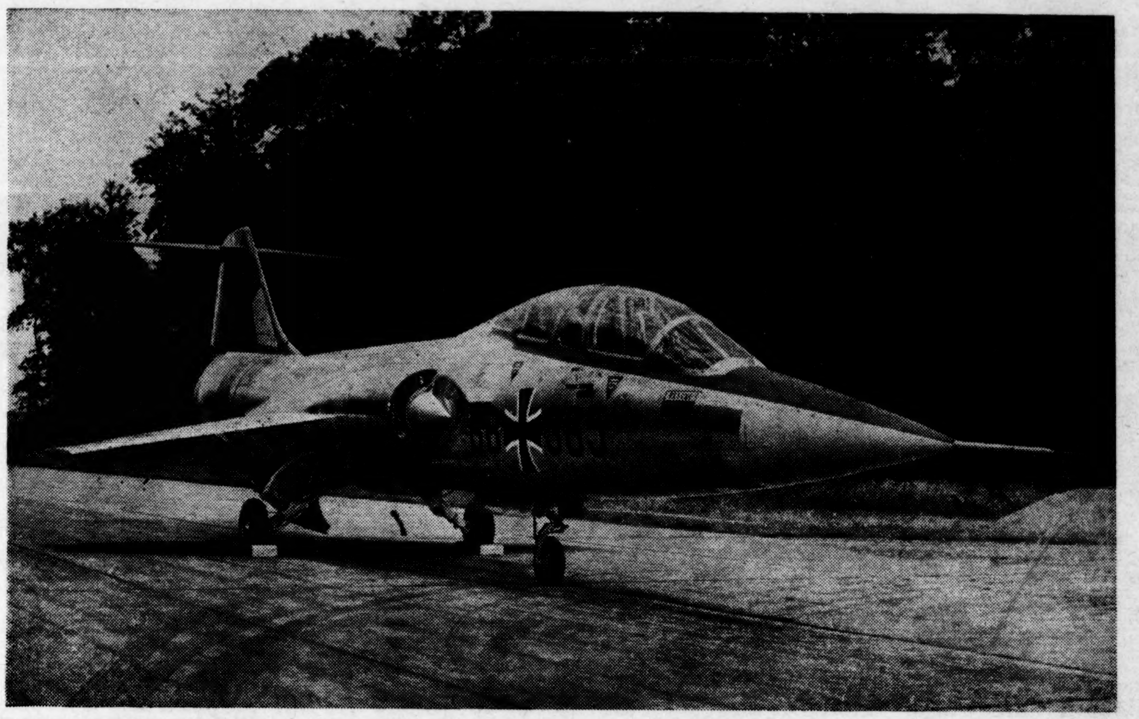
Germans Plan Combat Unit Modernization

By Cecil Brownlow

Bonn—Present West German air force plans, slipping because of production delays, call for the complete modernization of its combat wing structure with Lockheed F-104G all-weather interceptor-fighter bombers and Fiat G.91 close-support attack aircraft by 1965.

Total force at that time, if plans remain unchanged, will be 28 wings—including two transport and two helicopter—with approximately 1,000 combat jets. Qualitatively and quantitatively, this should give West Germany the strongest air force by far within western Europe by the 10th anniversary of its reactivation in 1955 with a smattering of already obsolescing aircraft and a nucleus of retrained World War II pilots.

More than 700 of these aircraft will be F-104s and about 250 will be G.91s. The first licensed-production G.91 is scheduled to roll off the production lines here by mid-summer, the first F-104G by late 1961. Initial quantities of both, however, already are being delivered from the U. S. and Italian production lines.



SEVENTEEN F-104D trainers have been delivered by Lockheed to the West German air force at Norvenich air base near Bonn, and training of student instructors is well under way.

NATO Wings

At present, the air force has 12 activated wings, of which six have been assigned to the operational command of the North Atlantic Treaty Organization. Since all West German forces must be NATO-assigned, under German treaty obligations with the United States, Great Britain and France, the other wings will be put at the disposal of Supreme Headquarters Allied Powers Europe as they become operational.

The jet combat force now in being consists of more than 900 aircraft, all at varying stages of obsolescence vis-a-vis the Soviet equipment they would have to face in event of war. One of the incongruities of the air force's fast buildup is the fact that some pilots are still being trained for the Republic F-84 and North American F-86 while others are being instructed on the F-104 and G.91. There are no steps in between.

Present wing structure provides:

- **Three interceptor wings** of Canadair Sabre 5 and Sabre 6 aircraft, one of which is operational and has been assigned to NATO. To speed the rebuilding program, Canada provided 75 Sabre 5s and the Germans purchased another 225 Sabre 6 day fighters. The two Sabre 6 wings, still in training, will be equipped with infrared versions of the Sidewinder air-to-air missile being produced under license in Europe in a cooperative effort by six NATO countries, including West Germany.
- **One all-weather fighter** wing of North American F-86Ks. Eighty-eight aircraft for the wing, which is still in training and represents Germany's only present all-weather capability, were manufactured under license by Fiat and purchased by the air force.
- **Five fighter-bomber wings**, four of which have been assigned to NATO, with a total of 450 Republic F-84F aircraft made available to Germany by the United States on a grant-aid basis.
- **Two reconnaissance wings** with a total of 108 RF-84Fs also made available on a grant-aid basis. Both wings are still being activated.
- **Two transport wings** composed primarily of Nord Noratlas transports. One wing has been assigned to NATO, the other is still in training.

First to go as the all-weather F-104Gs begin to trickle in will be the F-84F fighter-bombers followed in turn by the RF-84Fs, the Sabres and the F-86s. Germany at present has no close-support wings as such, and the five planned for the G.91 will all be new units.

Ultimate manpower goal for the air force is approximately 100,000 men of which 64,000 are now on hand despite still-serious difficulties in recruiting qualified personnel. The NATO goal of 1.5 pilots per aircraft has been met in two of the 12 activated wings, and it is hoped that it eventually will be reached in all of the 28 wings presently planned.

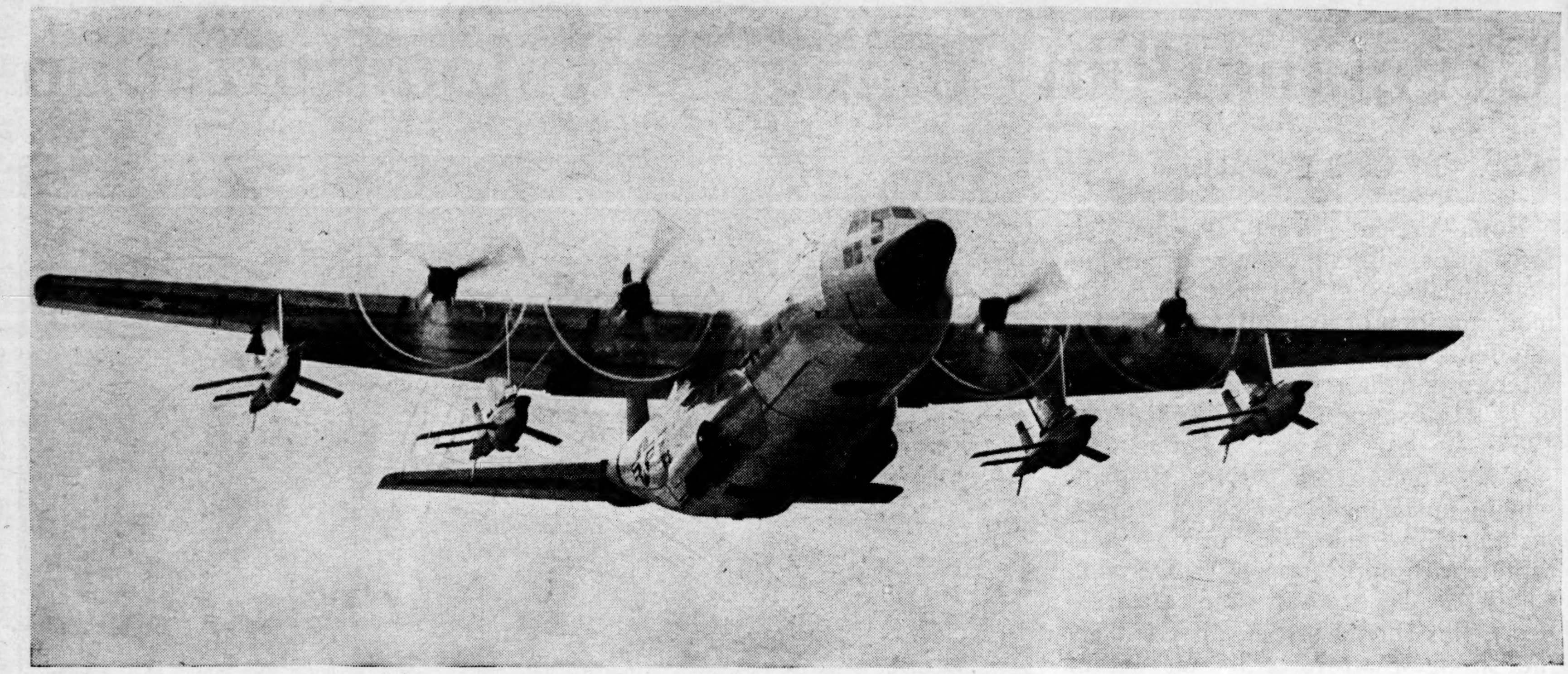
Top air force officials, many of whom believe that the politically touchy conscription period may have to be extended well beyond the present 12 months and other measures taken to make military service attractive to prospective volunteers, place major blame on two factors:

- **West German youth** and many older people, who remember the debacle of World War II, would like to be pacifist. "The U. S. educated us too well about the sins of war," one official says. Another adds that more education is "vital" to convince the German people that an adequate defense is necessary in the face of current threats from the east.
- **There is virtually** no unemployment in West Germany, wages are relatively high, working conditions usually good. Incentive to join the air force simply as a means of finding employment is virtually nil.

Six-Year Tour

Another possible dampener, but one viewed as necessary here, is the fact that a youth who wants to become a pilot—either non-commissioned or as an officer—must agree to serve a minimum of six years. Under such a minimum, the air force generally can estimate that a successful candidate will provide three years of productive service after spending roughly the same time training.

The air force originally had hoped to reach its 1,000-plane goal, with a substantial number of F-104s and G.91s delivered by late 1962. Those produced by the home factories will, of course, be available to the air force, but tooling for licensed production has been slowed by the extensive modifications in the basic designs of both air-



Lockheed Hercules Launches Ryan Firebee Target Drones

Lockheed GC-130A Hercules takes off from Tyndall AFB, Fla., carrying four Ryan Q2C turbojet-powered target drones hung under the wings. Hercules can take the drones to 30,000 ft. but dropped the Firebees from 16,000 ft. for this particular firing mission. Drones then climbed to 60,000 ft. Aircraft shown here flew 101 drone missions at Tyndall and Holloman AFB, N. M.

craft to meet the particular military needs and requirements of West Germany.

The air force's greatest day-by-day concern is the proximity of the potential enemy which could virtually knock down aircraft taking off from their home bases with air-to-air missiles fired from over East German territory. The threat of ballistic missile attack against the airfields is even more apparent.

Eventually, air force planners hope to go to a family of VTOL weapon systems that can be widely dispersed and hidden (AW Dec. 5, p. 72). As a step in this direction, current policy calls for the establishment of a single hardened base for the G.91s with four dispersal sites for each wing in times of alert. The F-104s will by necessity remain tied to vulnerable airfields with their long, eye-catching runways that make concealment impossible.

Air defense was formerly regarded as a national responsibility since the immediate airspace above a country is considered sovereign. West Germany, however, is now integrating its operation with a NATO organization for Central Europe encompassing France, Germany, The Netherlands and Belgium. Forces for the organization will include the aircraft of the respective countries plus Nike and Hawk antiaircraft missiles on sites in all four nations involved.

Nike already is operational, and Hawk sites probably will begin appearing next year. A difficulty for Germany here—and another reason VTOLs appear attractive—is the purchase of land for missile sites in an overpopulous country where property is zealously guarded.

Scarcity of land also precludes the training of missile crews in Germany. For the moment, at least, missile crews must be sent to the United States for their training and returned periodically in order to fire a practice round. This and the nearness of the Iron Curtain are the major reasons Germany feels it must look elsewhere to find adequate training sites and logistic supply depots.

Present training space available in West Germany totals 353,353 acres as opposed to an estimated 827,044 acres available to Soviet and East German forces in East Germany.

Although still a touchy issue in some areas, German air force crews have been permitted to quietly fly into such places as Sardinia and Turkey for gunnery training. A number of supply depots for the German military services have been tucked away in other West European countries farther away from the border, and France and West Germany are negotiating over the possibility of air force aircraft of the latter country using two French air bases, one located on Corsica and the other near Marseilles.

German student and instructor-pilots also are making cross-country training flights into airfields ranging from Norway to Turkey under agreements with the countries involved. The F-104 instructor pilots checking out on their new aircraft make almost nightly high-altitude flights over other nations of western Europe. The restricted land areas within West German borders demand this.

Headed in the wrong direction, an F-104D two-seat trainer taking off from Norvenich air base approximately 30 mi. from Bonn could be over the East German border within 12 min. On a high-altitude, high-speed flight from directly over Norvenich, he would be there in six minutes.

To avoid any chances of this, all possible flights from Norvenich are pointed in the opposite direction. On a recent night-navigation training flight, for example, an F-104 student and his instructor flew this 552-naut.-mi. nonstop mission in 1 hr. 11 min. flight time:

- **Norvenich to radar check point** over Belgium.
- **Belgium to another check point** near Paris.
- **Paris to Bray-sur Seine** in France.
- **Bray-sur Seine** to Luxembourg.
- **Luxembourg to Spangdahlem** air base in Germany.
- **Spangdahlem to Cologne** and home to Norvenich.

The first F-104D arrived at Norvenich, with its 8,010-ft. runway, in July, and the total will soon reach 27. (Of the 30 F-104Ds ordered from Lockheed by the German air force, two will remain at Palmdale for the present to check out German flight-acceptance test pilots; a third will be shipped to the maintenance school at Kaufbeuren).

Aside from their training duties, these 27 planes will be organized into a standard-size German fighter-bomber squadron—25 line aircraft plus two spares.

Airframe for the F-104D is crated in the United States by Lockheed, its J79 turbojet engine by General Electric, and shipped to Norvenich for reassembly by German air force technicians and Messerschmitt employes under the guidance of representatives from the two U. S. companies.

At the moment, Lockheed has 21 representatives at Norvenich, including flight-test acceptance pilots, and General Electric has two. Although there have been some difficulties in keeping the spares supply flowing during the initial buildup stages, air force officials describe the United States-German cooperation thus far as "very, very good."

"We may have our problems with other people," one official said, "but with Americans, no."

United States representation at the field—which also includes two U. S. Air Force instructor pilots—will gradually be reduced as the German technicians and instructors become more familiar with their task. Messerschmitt, for example, which has responsibility for final assembly of 210 of the F-104Gs scheduled to be produced in Germany—is having pilots trained to take over the flight-acceptance tasks.

First six student-instructors for the F-104D were trained on the aircraft in the United States at Lockheed's Palmdale facility and at Edwards AFB, Calif. Five of these are now training a second group of six student-instructors at Norvenich. At least two of these will be transferred to the United States as flight-acceptance test pilots, and another Norvenich class will begin shortly to round out the number to 12.

These 12, in turn, will begin training the first of an estimated 1,000 operational pilots needed for the F-104Gs sometime next spring, probably in March. All instructors have a minimum of 400 hr. on operational jets, and their first students will have at least 250 hr., although this latter number of hours may decline as the training program wears on and the supply of qualified pilots becomes strained.

Student instructors agree, however, that, in the transition from the F-84F, "you are behind this airplane on the first few missions, and we hope we don't have to get anybody here coming straight from T-birds" (Lockheed T-33 trainers used by the air force training command—Kommando der Schulen der Luftwaffe).

Training of forthcoming students will follow the same general pattern as that given to the instructors and is expected to require approximately three months for each group. Classes, hopefully, will be limited to about 36 students, or three to an instructor.

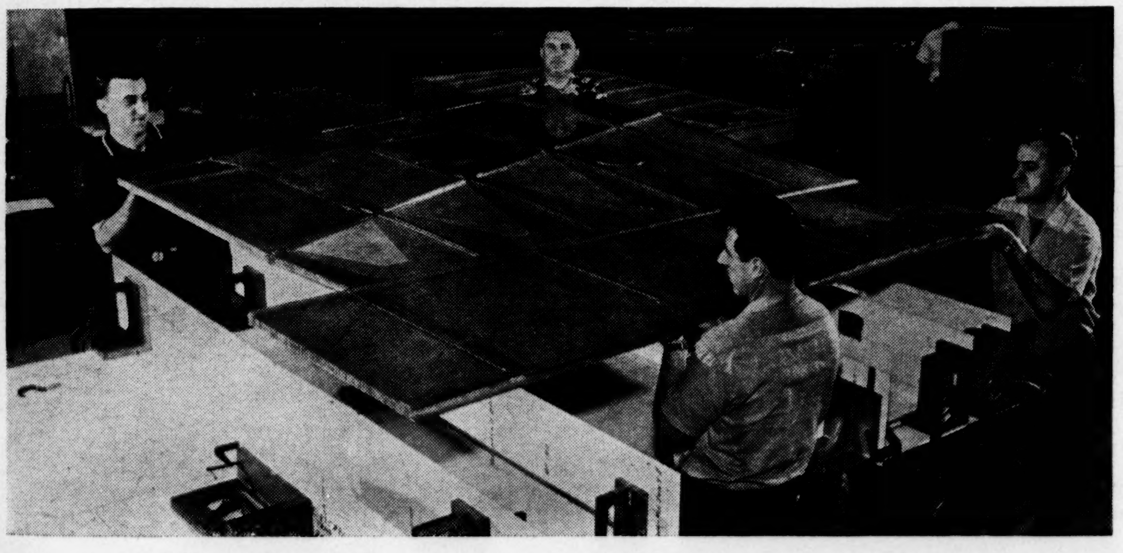
Student-instructor pilots begin with 72 hr. of ground training, with the greatest number of hours going to the landing gear, braking and drag chute systems (eight), the J79-7 engine (six) and the hydraulic system (six).

The following "basic" flying phase consists of 24 flights totaling approximately 36 hr. First four flights, including one at Mach 2, are devoted to familiarizing the student with the feel of the aircraft and with its performance limitations at both ends of the regime.

First solo generally comes with the fifth flight, and the remaining syllabus is devoted primarily to instrument, formation and navigation training.

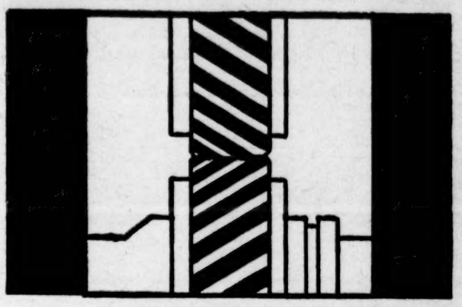
At this point, the regular students probably will be transferred to squadrons for their operational training—gunnery, tactics, air-to-air missilry, etc. Student-instructors, however, have another 11 hr. at Norvenich, with emphasis on such matters as the proper approach to take toward students, backseat landing and methods of taking over control of the aircraft in emergencies.

First few G.91s have been delivered to the air force's Waffenschule 50 at Erding air base, and the initial instructor courses are under way there. Here, students will arrive after receiving between 15 and 16 hr. of primary training on the Fouga Magister and move directly to the G.91. Training Command officials hope that they can be dispatched to their operational units after approximately 40 flying hr. at Erding.



North American Builds B-70 Panel

Honeycomb panel for North American B-70 Mach 3 bomber is lowered onto a cradle at the company's Los Angeles, Calif., plant. Complex structure is 10 ft. x 10 ft. and is built on three planes in a "Z" pattern. Section was chemically milled to reduce weight.



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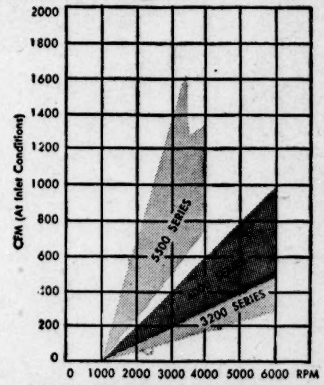

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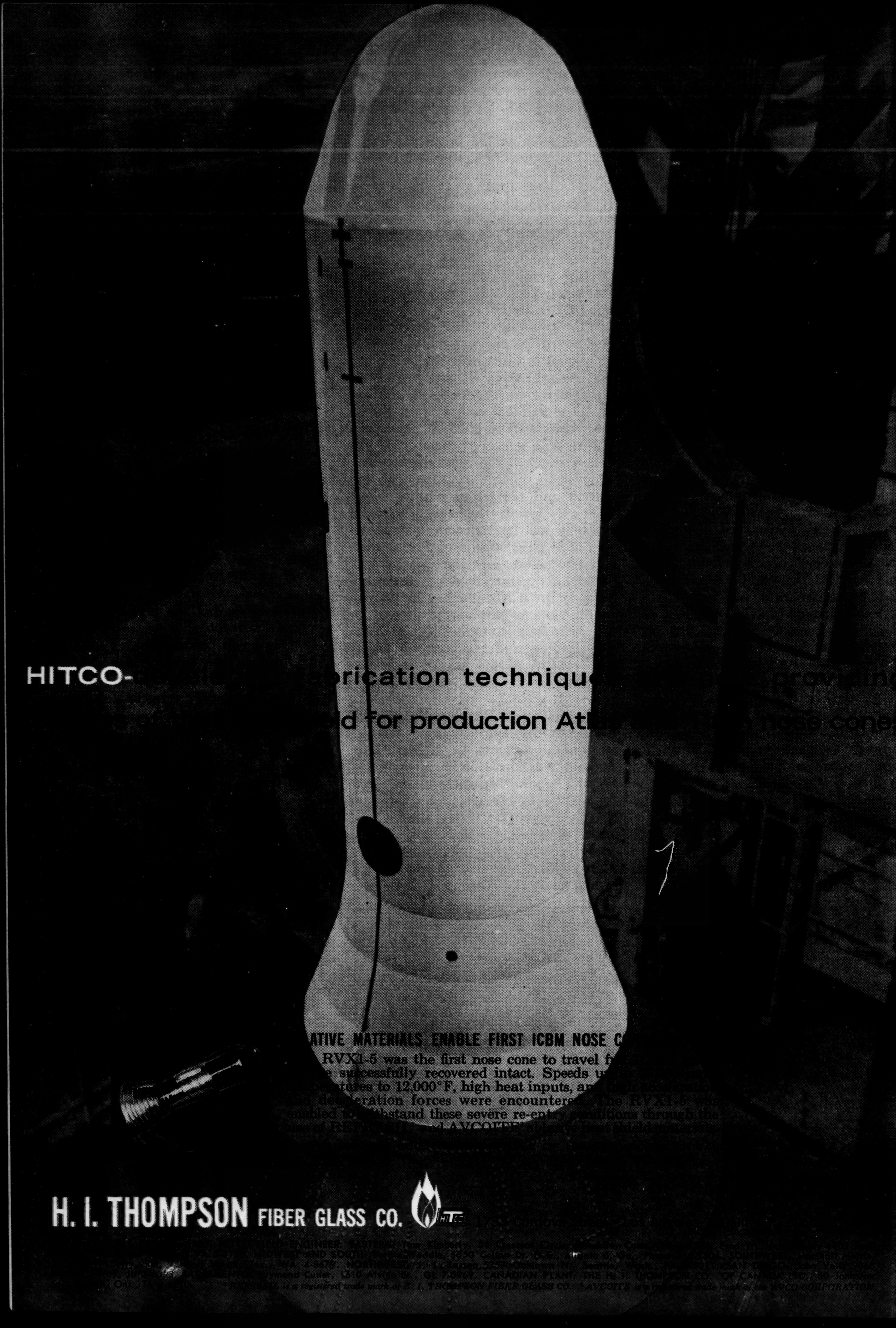

HITCO-[illegible]rication technique[illegible] providing [illegible]ld for production Atl[illegible] nose cones

[illegible]ATIVE MATERIALS ENABLE FIRST ICBM NOSE C[illegible]

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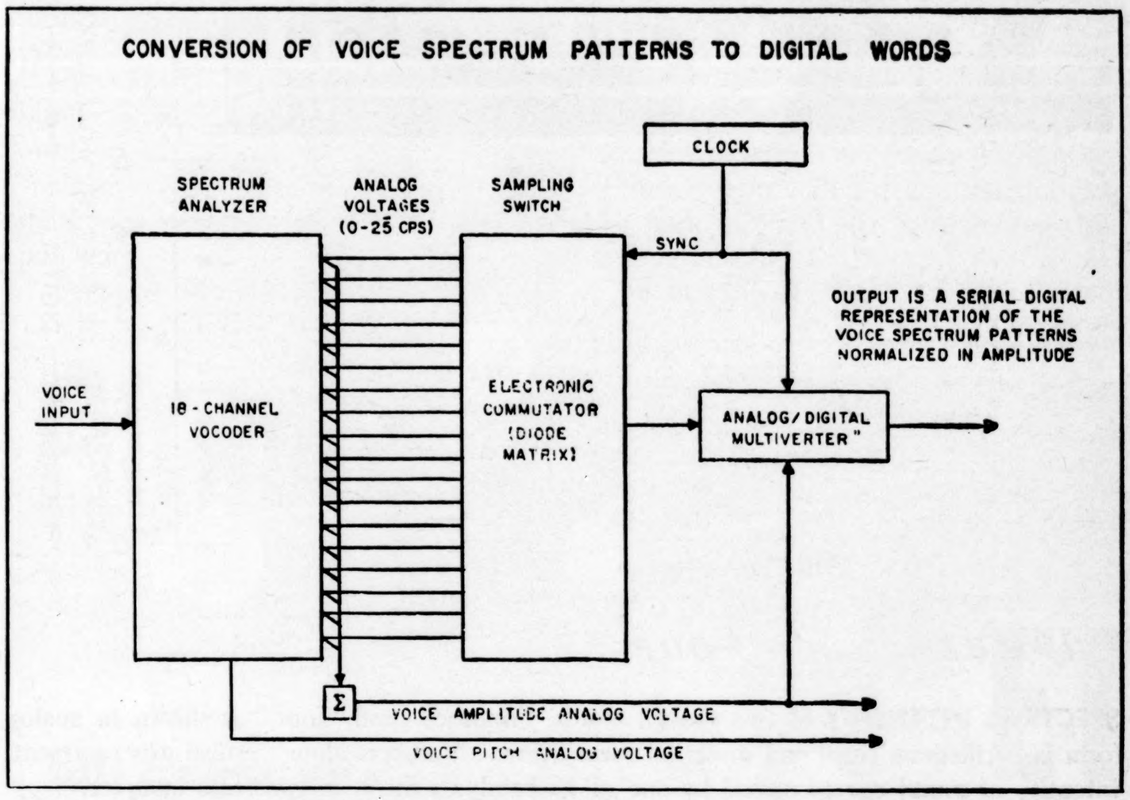
Computer Responds to Voice Commands

By Philip J. Klass


CONVERSION OF VOICE SPECTRUM PATTERNS TO DIGITAL WORDS
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ANALOG VOLTAGES (0-25 CPS)
SAMPLING SWITCH
SYNC
OUTPUT IS A SERIAL DIGITAL REPRESENTATION OF THE VOICE SPECTRUM PATTERNS NORMALIZED IN AMPLITUDE
VOICE INPUT
18 - CHANNEL VOCODER
ELECTRONIC COMMUTATOR (DIODE MATRIX)
ANALOG/DIGITAL MULTIVERTER"
Σ
VOICE AMPLITUDE ANALOG VOLTAGE
VOICE PITCH ANALOG VOLTAGE

VOICE COMMUNICATION with a digital computer, achieved by Air Force Cambridge Research Laboratories, uses an 18-channel vocoder and spectrum analyzers to convert voice spectrum patterns into digital words for storage and subsequent comparison with spoken commands in order to recognize the word, and, in some cases, the speaker.

New York—Recent experiments by the Air Force Cambridge Research Laboratories indicate that it will soon be possible for operators to use voice to communicate with digital computers for speedy insertion of real-time data. This also suggests the possibility of a computer being able to talk directly to its operators.

In AFCRL tests, a small digital computer with a relatively simple speech analysis accessory has successfully and consistently been able to recognize different spoken words, S. R. Petrick reported here at the recent Eastern Joint Computer Conference. The report was co-authored by Miss H. M. Willett.

Using this basic word recognition technique, AFCRL has successfully demonstrated these other byproduct techniques, Petrick reported:

- **Simple language translation,** in which a word spoken in one language is recognized by the computer, translated into a second language and typed out in printed form.
- **Individual speaker recognition,** in which the computer is able to identify which of several operators is talking from the characteristics of his speech.
- **Adaptive programs** which enable the computer to automatically adjust itself to a different speaker's manner of talking.
- **Mathematical problem,** expressed in terms of numbers, plus, minus, times, brackets and equals, can be accepted in human voice form, with the computer recognizing the required mathematical operations and then performing them to solve the equation.

Test Limitations

The computer used in the experiments in the AFCRL Cambridge Computer, a serial machine with relatively small storage of only 1,600 words. This limited the recognition tests to a vocabulary of about 83 different spoken words and required about 1.5 sec. for recognition of each spoken word. Use of larger, faster machines would permit a greatly enlarged recognition vocabulary and much shorter recognition time.

The method used to recognize individual spoken words in the AFCRL experiments differs considerably from that reported by International Business Machines Corp. in its speech recognition tests (AW Oct. 3, p. 67). In the IBM experiments, the vocabulary was limited to 10 digits, zero through nine, and discrimination was based on inherent phonetic differences between each of the digits—existence or absence of spoken sounds and weak or strong fricative sounds and their relative location in the word.

Cambridge Research Laboratories use a stored reproduction, called a mask, of each word which is to be recognized when spoken by the human operator who will talk to the machine. The mask is a time-sampled, spectral-intensity plot of the word expressed digitally. The human operator normally will repeat the word several times so the machine can form a mask which can accommodate variations in a single individual's speech pattern. The operator then types into the computer the printed equivalent of the word he has spoken. The process is repeated until the required vocabulary has been stored in the machine.

When the stored vocabulary masks are prepared by the same person whose voice will communicate with the computer, his spoken words can subsequently be identified "with almost 100% accuracy," Petrick said. If the subsequent words come from another operator, the degree of success will depend largely upon the similarity of the speech characteristics of the two individuals involved.

The technique used to analyze spoken words and prepare recorded masks, described below, makes it possible to discriminate between different speakers on the basis of the manner in which they voice and enunciate words, AFCRL tests indicated.

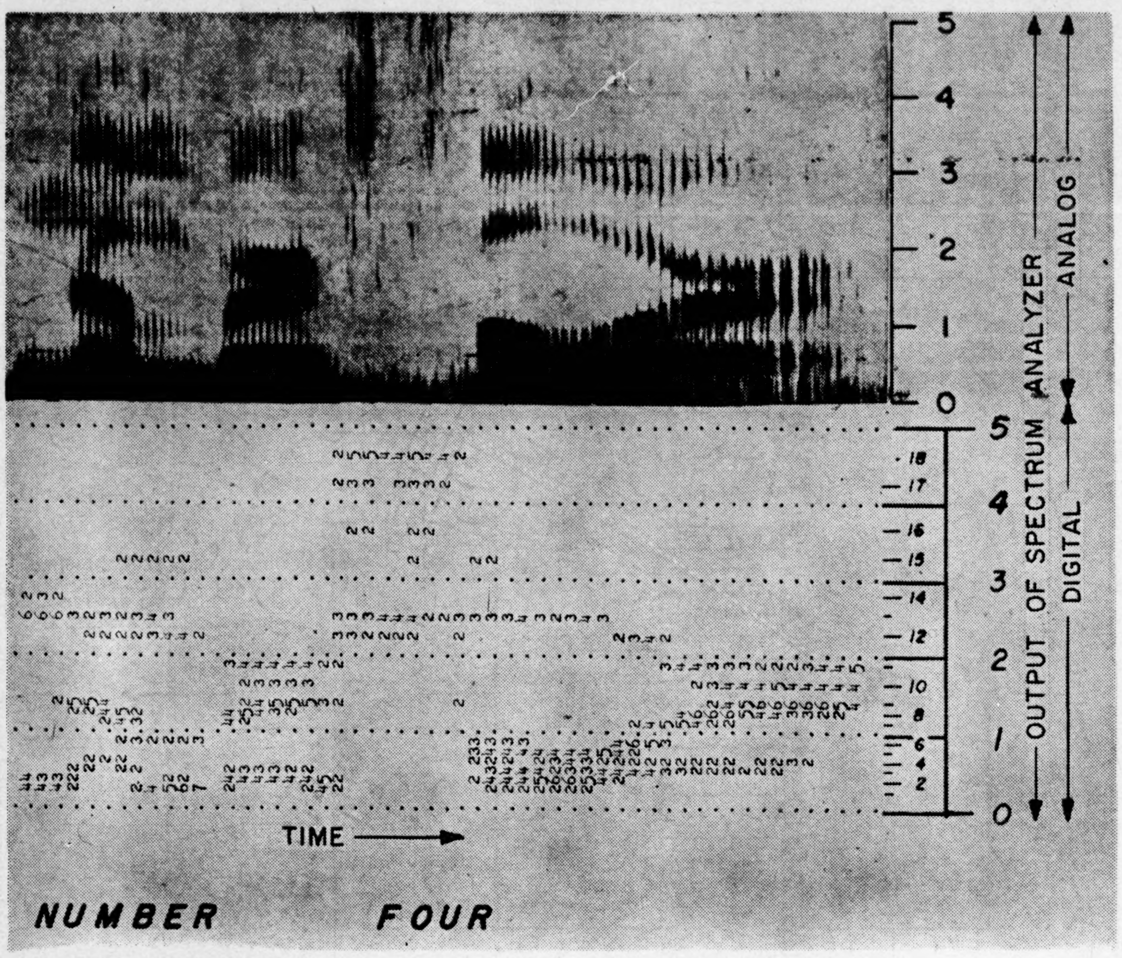
Test Series

To test this capability, AFCRL scientists used nine male speakers and seven female speakers and stored masks of each of their voices speaking the words "one," "two" and "three." Each speaker spoke each of the three words a total of four times, giving the computer four samples of each individual's voice for the preparation of each stored mask.

After masks had been prepared for the 16 voices, each of the 16 then spoke the words "one," "two" and "three" to the computer and the machine attempted to determine which of the 16 subjects was at the microphone.

In the case of the seven female subjects, the computer was able to identify each speaker every time (every word), while for male subjects the machine scored 93% recognition. Average for the whole group, based on 283 spoken sample words was 96%, Petrick reported.

Encouraged by these results, scientists wrote another computer program, using the 48 word masks (16 x 3) pre-



SPECTRAL INTENSITY of two spoken words, "number" and "four," is shown in analog form in oscillogram (top) and in digital form below. Numbers along vertical axis represent intensity of sound energy passed by one of 18 bandpass filters in spectrum analyzer.

viously stored. One of the 16 subjects would speak the word "one," "two" or "three" into a microphone and the computer would then automatically give one of the following types of response:

- **That was John Jones** speaking the digit three.
- **Can not identify speaker,** but the digit was three.
- **Can not identify speaker** or the digit; repeat and speak more distinctly.

A fourth possibility, in which the computer identifies the speaker but cannot identify the word he spoke is not yet possible with the experimental system. However, Petrick says that it appears feasible with at least a fair degree of success and is under active consideration.

Adaptive Reorientation

AFCRL scientists developed two self-adapting programs intended to enable the computer to adjust itself to a new speaker for which it has no pre-recorded mask. The first requires a human operator to make certain decisions, while the second requires no human intervention. In both cases, the masks of words which comprise the computer's stored vocabulary are spoken by one or a group of speakers.

Where a human instructor is available, the computer makes a positive identification if it finds sufficient correlation betwen a word spoken by a new operator and a similar word mask in its storage. If the correlation is only moderate, the computer makes its best guess, prints it out and asks the human instructor whether it made the correct choice. If the machine learns that it has made a correct choice, it then modifies its original stored word mask to incorporate a small fraction of the characteristics of the word spoken by the new speaker.

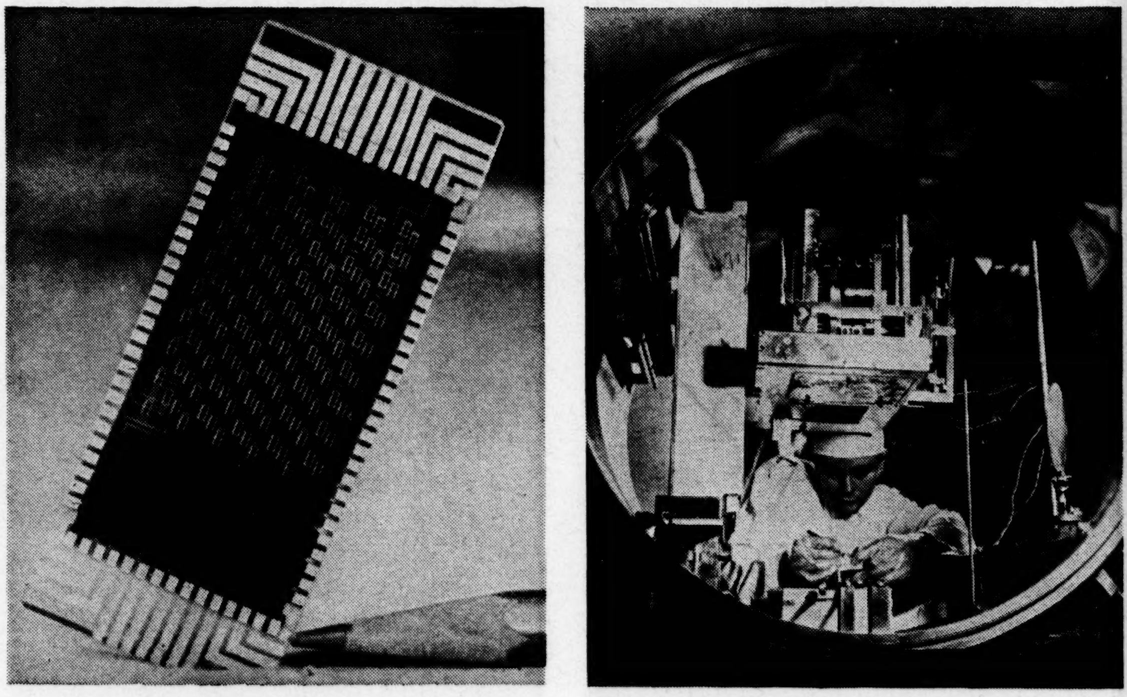
If the machine makes the wrong choice, the operator types the actual spoken word into the machine. The computer scans its stored vocabulary to be sure it has such a word in storage. If so, the machine then modifies its original stored word mask to incorporate a larger fraction of the characteristics of the word just spoken by the new speaker than it would have done if it had made the correct choice.

If the word voiced by the new speaker sounds completely different from any of the computer's word masks in storage, it asks the human instructor for assistance. He then types in the word just spoken and the computer searches its memory to see if it has such a word in storage. If it finds the word, the original stored mask is modified by a still larger fraction of the newly spoken word characteristics.

Computer Queries

Whenever the correlation is so poor that the computer must ask for human assistance, either to confirm its choice or to identify the spoken word, the computer will ask the speaker to repeat the word. If the machine again has trouble identifying it, an increasing fraction of the word's characteristics is introduced into the stored mask. If the computer still has trouble after several repeats, it either stops or, at the option of the user, it replaces the original stored mask with the last repetition of the word.

The second adaptive learning program, which requires no human intervention, automatically adjusts the



IBM Produces Thin-Film Memory Plane

Cryogenic thin-film memory plane (left), consisting of 135 cryotron elements built up in 19 layers, providing 40 bit storage plus access and switching between memory planes, has been produced by International Business Machines Corp. using new automatic control techniques. Word-register selection is accomplished with equipment operating at room temperature. Fabrication of thin-film memory planes is carried out in cylindrical vacuum tank (right) by means of sequential deposition process using 17 microscopically adjusted masks. IBM says that process automatically produces duplicate memory planes with similar characteristics once the masks have been properly aligned. Tank is evacuated to 10^{-7} mm. Hg.

amount of stored mask modification and the fraction of the new spoken word characteristics used in this modification, as a function of the amount of correlation between the new spoken word and the original stored mask. But this self-learning program may not always adapt to the new speaker's voice, AFCRL tests indicate.

Because it is so easy and quick to record word masks for a new speaker, it may be simpler to ask a new operator to run through a brief training routine in which the machine prepares new word masks tailored to his manner of speaking, Petrick indicated.

Heart of the pattern recognition technique used by AFCRL is a vocoder, containing 18 bandpass filters, which decomposes each spoken word into 18 frequency segments in the audio band. The output of each filter goes to a corresponding spectum analyzer which measures the power denisity of the sound in this segment of the spectrum.

The output of each spectrum analyzer therefore represents the magnitude of the sound energy in its segment of the audio spectrum. The output of the spectrum analyzers will vary with time as the intensity of the voiced sounds varies.

The output from each of the spectrum analyzers is sampled in sequence by an electric commutator (multiplexer), then converted into a three-bit binary number which represents its amplitude.

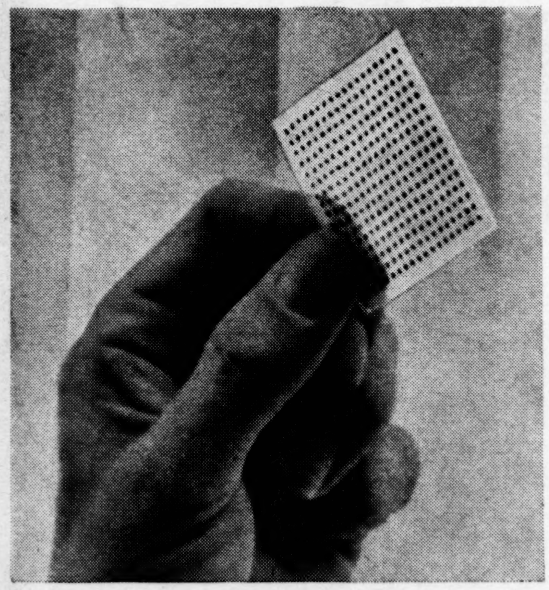
The rate at which the spectrum analyzer outputs are sampled, and the number of such samples used in preparing the stored mask, depends in part upon the number of words in the operational vocabulary and the relative difficulty of discriminating between similar-sounding words. The larger the vocabulary and the more difficult the discrimination task, the higher must be the sampling rate and the larger the number of samples used in the stored mask.

In AFCRL experiments, the sampling rate used was 50 per second. The number of samples of each spectrum analyzer output used in the stored word mask was varied between three and 18 per word.

Because of the different duration times of different words, normalization was used so that the stored masks of every word would have the same number of samples.

AFCRL scientists conducted experiments intended to evaluate the comparative accuracy of voice and word recognition as a function of the number of samples per word used in the stored mask and as a function of the number of frequency segments into which the voiced word was decomposed. The latter included decomposition into 18, nine, six and three frequency channels.

Following are some of the results of



Univac Thin Film

Thin-film memory will perform control function in new Univac 1107 Thin-Film Memory Computer, providing access time of 0.6 microsecond, less than half that required for previous ferrite cores. New computer uses ferrite cores for main memory, providing 16,384 to 65,536 words of storage. The new solid-state Remington Rand data processing system will rent for $40,000 to $60,000 per month.

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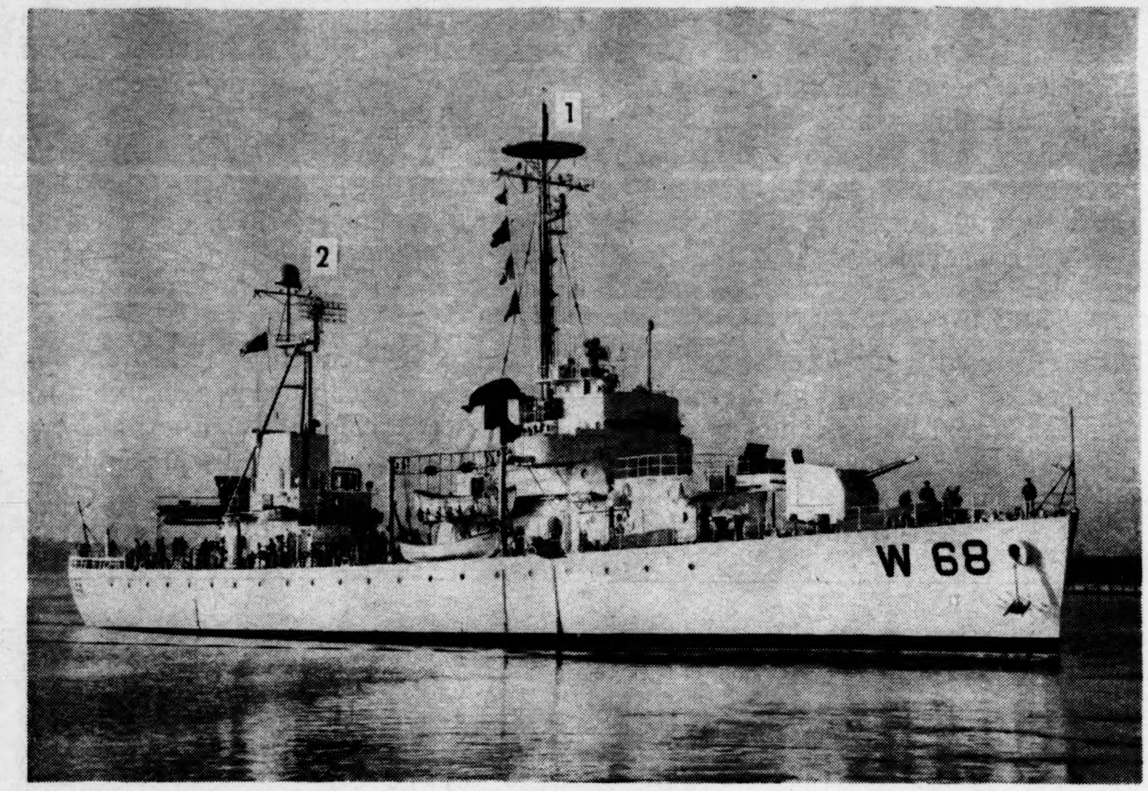


Ocean-Based Vortac Navigation Aids Tested

Ocean-going Vortac on the Coast Guard Cutter Androscoggin has just completed three week tests at Ocean Station Charley, 550 mi. southeast of Greenland, as part of Federal Aviation Agency program to evaluate use of ocean-based Vortac navigation aids across the North Atlantic. Nearly 700 aircraft utilized the Androscoggin's navigation services during three-week test period. Ship carries a VOR (omnirange) and Tacan transmitter, providing service for both civil and military aircraft. VOR antenna (1), mounted atop a 75-ft. mast with 15-ft. diameter counterpoise below, is not stabilized in pitch or roll, while Tacan antenna (2) atop a tripod mast is stabilized for ship roll up to 20 deg. Both are corrected for changes in the ship's heading.

these tests, using spoken digits "zero" through "10", which show one effect of varying the number of samples per word and the number of frequency segments:

- **98.7% recognition** using nine samples and nine frequency channels.
- **96.1% recognition** using nine samples and three frequency channels.
- **100% recognition** using five samples and nine frequency channels.
- **93.5% recognition** using five samples and three frequency channels.
- **94.7% recognition** using three samples and nine frequency channels.
- **86.0% recognition** using three samples and three frequency channels.

Because of storage limitations in the Cambridge Computer, spoken inputs (words) were limited to no more than two seconds duration in the AFCRL tests.

Words of greater duration could be handled with a computer having greater storage, but words still must be spoken as individual words separated by distinct pauses, or means must be developed to "segment" continuous speech into distinct words, Petrick said. Work on this segmentation problem is being carried on by several groups, he added.

AFCRL currently is considering the use of a larger scale computer and a 500-words vocabulary for further exploration of techniques for voice communication with digital computer, Petrick said.

The degree of success achieved in AFCRL tests, using simple voice pattern recognition techniques, "would seem to indicate a great promise for rapid advancement in oral communication with digital computers in the near future," Petrick concludes.

Both Petrick and Miss Willett are in the Computer and Mathematical Sciences Laboratory, Electronics Research Division of the Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Mass.

Quartz Crystals Being Produced in Quantity

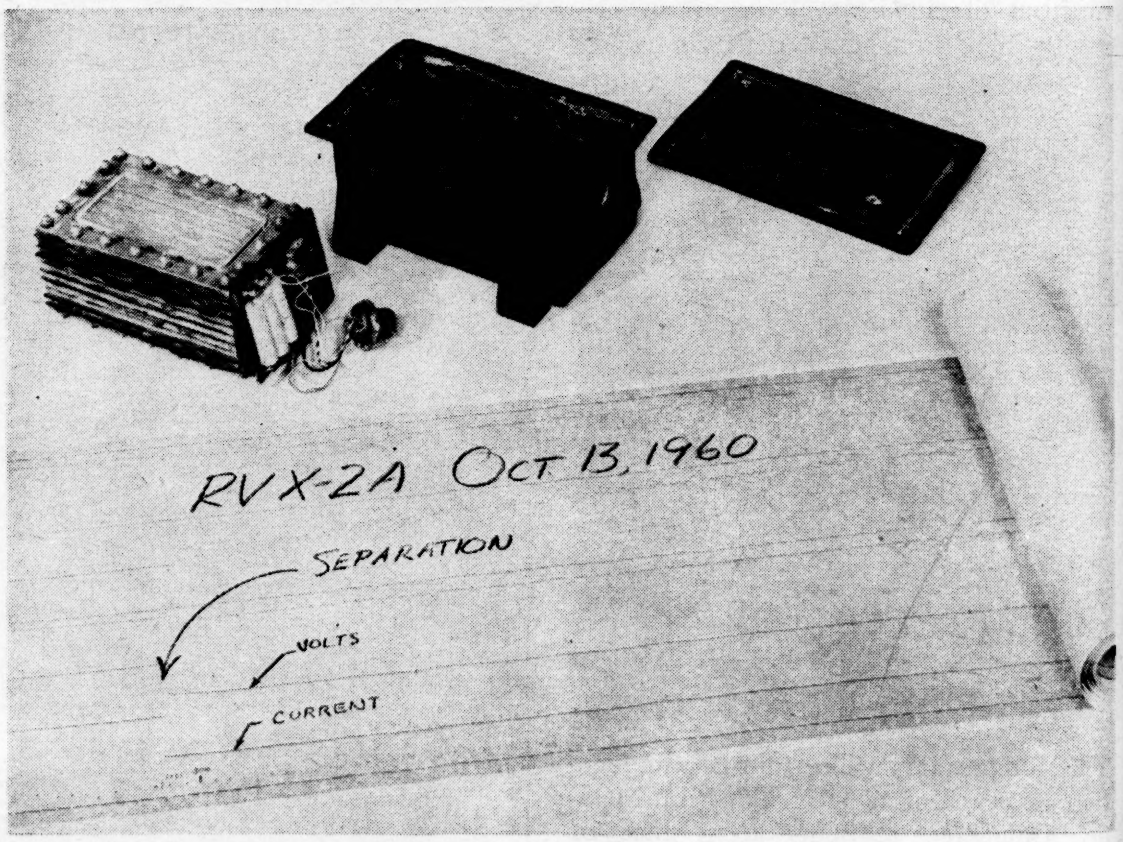
Mass production of synthetic quartz crystals has begun at Western Electric's Merrimack Valley Works factory at North Andover, Mass.

Crystals, used in frequency-modulated equipment, are grown in 20 10-ft.-long, 1-ft.-dia. vessels. Seed crystals of natural or artificial quartz are suspended in upper half of vessels; lower half is filled with chunks of natural quartz. Weak alkali solution is poured over the chunks and the vessel then heated to 700F.

Quartz chunks dissolve under heat and pressure (approx. 25,000 psi.), rise to the cooler upper half of the vessel and there redeposit on seed plates.

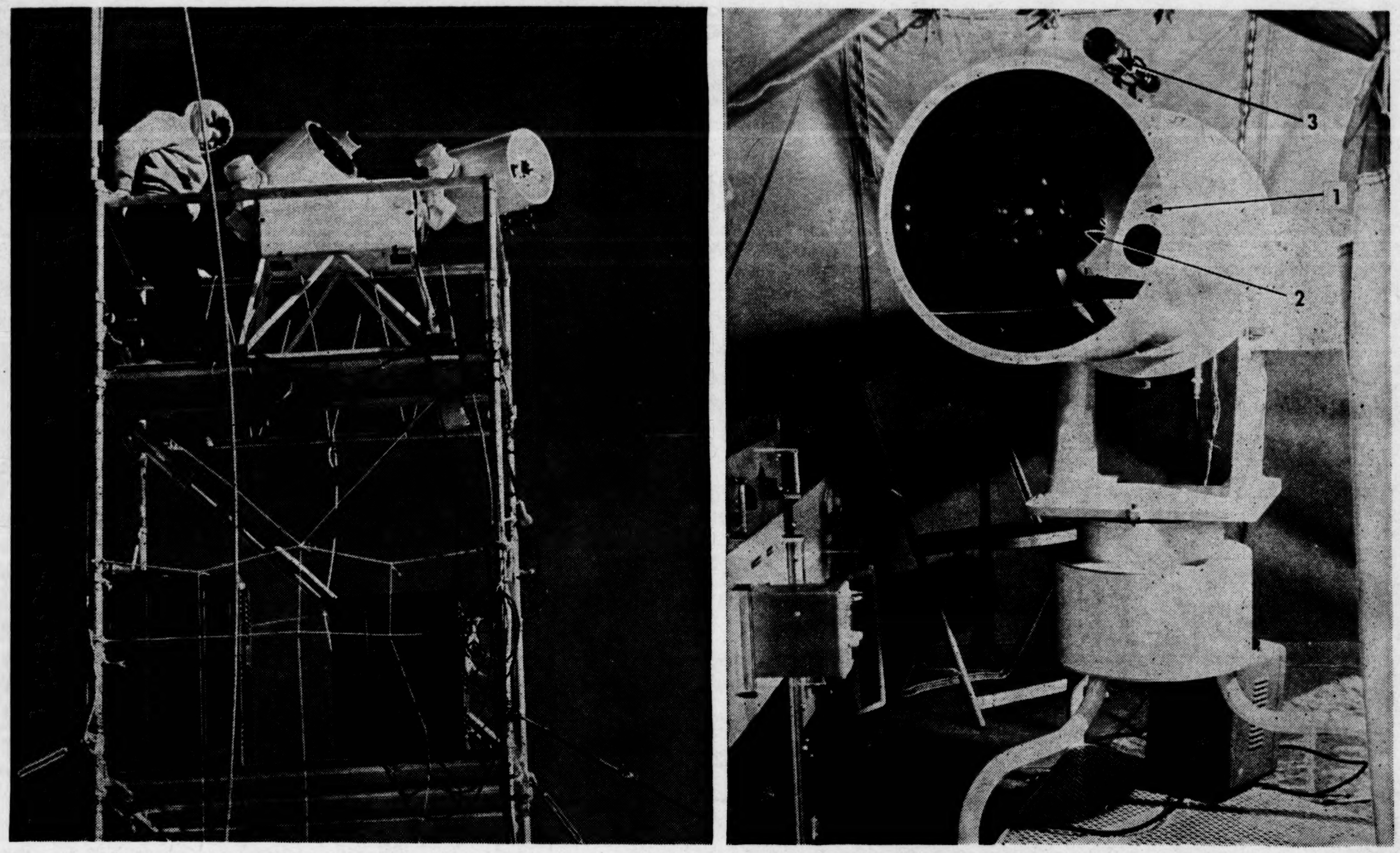
The over-all cycle takes approximately three weeks.

Western Electric can produce 700,000 units (each approximately 6½ in. long, 1½ in. square) from 20,000 lb. of raw natural quartz annually.



Fuel Cell Performs in RVX-2A

Fuel cell developed by General Electric's Missile and Space Vehicle Department performed successfully under zero gravity conditions during 30 min. flight time of General Electric's RVX-2A research vehicle. Telemetered information, transcribed on roll in photo, showed no fluctuation in voltage or current in flight. Sharp changes noted occurred when synthesized load was applied to the battery at separation.



SOLAR COMMUNICATION transmitter (left) part of experimental solar communication (SOCOM) system (AW May 2, p. 164), developed by Electro-Optical Systems, Inc., under Air Force contract, gathers sun's light, modulates and retransmits it to receiver 8 mi. away during recent Mojave Desert tests. With special filters, system simulated transmission over millions of miles in space. Receiver of experimental solar communications system (right) consists of a double mirror system, a photomultiplier, signal processing and readout gear. Double mirror system is a Cassegrainian array, one in which light impinging on a parabolic mirror (1) is reflected to a second mirror (2) and focused back through a hole in the first. Receiver with pyroheliometer (3) for measuring solar power is shown inside a tent during field tests in the Mojave Desert.

Solar Communications Prototype Tested

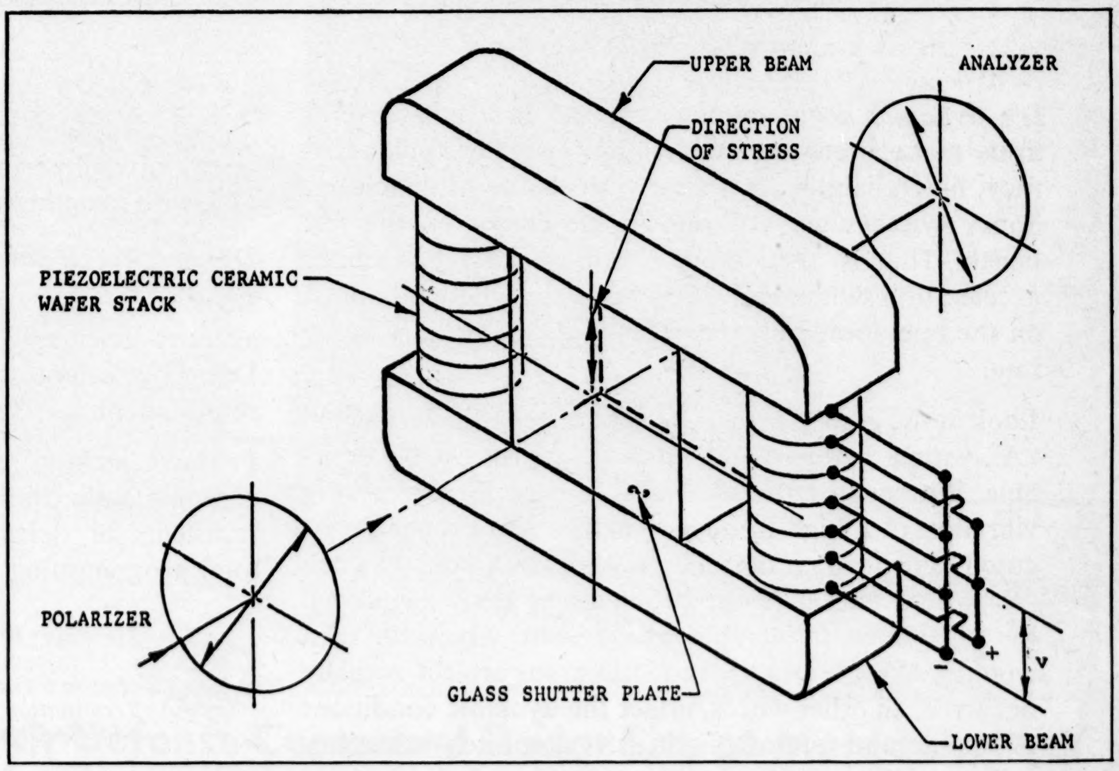
By Barry Miller

Edwards AFB, Calif.—Desert field tests of an experimental communications system which employs the sun's light as an information carrier recently demonstrated the feasibility of obtaining long-distance space communications using optical frequencies.

The tests were conducted in the Mojave Desert near here by engineers of Electro-Optical Systems, Inc., of Pasadena, Calif. Equipment under test was a prototype of Electro-Optical's SOCOM (solar communications) system (AW May 2, p. 164).

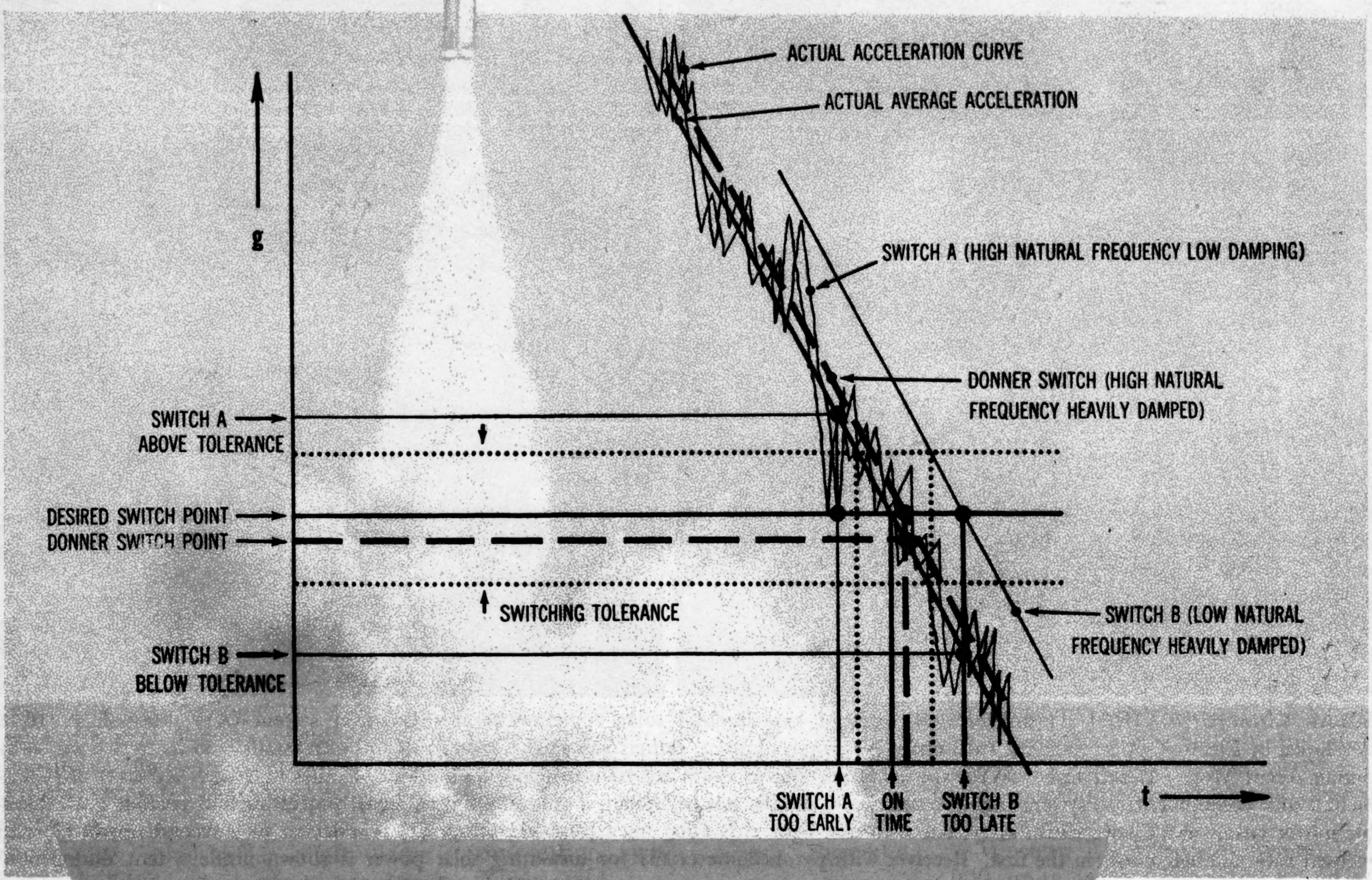
This equipment was developed for the U. S. Air Force's Wright Air Development Division under an 18-month, $467,234 contract.

Purpose of the tests was twofold—to see if prototype equipment operated satisfactorily and to show that optical systems are suitable for space communications. An eight-mile line-of-sight stretch of arid desert area was selected for the tests because of the absence of background light along the transmission path and the relative freedom

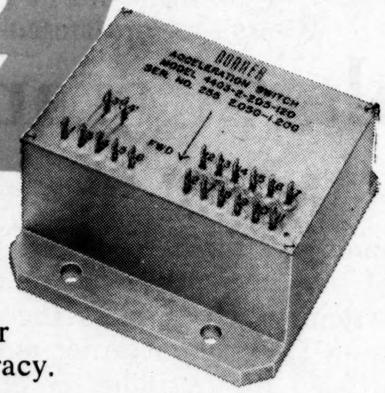


MODULATING VOLTAGES applied to piezoelectric (barium titanate) stacks produce strains in rigid beams supporting a common glass plate of the stressed plate shutter. These strains alter optical properties of glass, changing plane of polarization of light passing through this electromechanical modulator employed in solar communications system. This modulator makes possible the transmission of information by the solar communications system over simulated distances of at least 7 million mi.

There's only one reason to specify Donner acceleration switches



..BECAUSE THEY UNDERSTAND THE MEANING OF ACCURACY



It's dynamic accuracy that counts. In truth, several firms make precision acceleration switches. But accuracy, like reliability, is a term with shades of definition. Some switches are accurate in the lab or on the test bench. That is, they provide *static* accuracy. Donner acceleration switches give you accuracy where it counts, on the operational missile. They are *dynamically* accurate.

Look at the graph above. Under static conditions, switch "A" with a better switching response, might be desirable. But suppose the missile were experiencing a 10 g vibration of a high frequency nature and proper thrust cutoff depended on detecting a 2 g switch point. Switch "B" would eliminate the problems of early switching, but introduce intolerable phase shift which in turn would make the switch "see" the event after it actually occurred. In other words, under the dynamic conditions of missile and aircraft flight, it is absolutely necessary to know when an event occurred rather than precisely where it occurred. Frequency response becomes a more important consideration than switch accuracy.

Heavily damped, with a high natural frequency, Donner acceleration switches have low phase shift providing the transient response necessary to follow rocket engine operation and perform their task with meaningful accuracy.

Donner Acceleration Switches are Flexible

Because of the inherent flexibility of Donner's basic accelerometer servo system and associated electronics, Donner acceleration switches will satisfy virtually any requirement.

Features include multiple switch points, any specified damping ratio, built-in time delays to overcome initial transients or delayed output, memory damping, and total programming capacity.

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from atmospheric absorption or scattering.

Long distances over which this or other optical systems might be expected to transmit in space were simulated by attenuating the intensity of light beams with special filters located in the transmitter and the receiver.

According to Electro-Optical, test results with this equipment indicate that:

- **Information can be transmitted** at least two to three million miles using a transmission rate of about 10 bits/sec. at maximum range. Light signals without information content were received over 10 million simulated miles. Information could be transmitted over the latter distance, Electro-Optical engineers say, by installing larger transmitter collector mirrors than the 12-in. reflectors now employed. Various distances were simulated by use of suitable filters chosen on the basis of inverse square law calculations.
- **Signal noise ratio** of 16 db. (measured to the receiver preamplifier output) was obtained for simulated transmission distance of 1 million mi. Bandwidth was 20 cps.

Communications and radar systems which use optical (visible light, infrared or ultraviolet) rather than conventional radio waves have attracted special attention in the past two years. In space these systems would be free of atmospheric effects which would severely curtail their usefulness in terrestrial applications. Possible value in space might hinge on the security and relative invulnerability to jamming provided by narrow beams of light. Additionally light weight, reliability and low power needs of optical and associated electro-optical or electronic equipment are among other advantages frequently claimed for optical systems.

This growing interest in optical wavelengths for signal generating systems was further stimulated by recent success in generating relatively coherent light with optical Masers. Optical Masers should provide more narrow, high intensity beams than sun beams handled by SOCOM. Beam width of light generated by Bell Telephone Laboratories optical Maser (AW Oct. 24, p. 75) was 0.1 deg. This is $\frac{1}{5}$ the width of the $\frac{1}{2}$ deg. beam of sunlight gathered in by SOCOM's glass collector system and employed as the basic carrier.

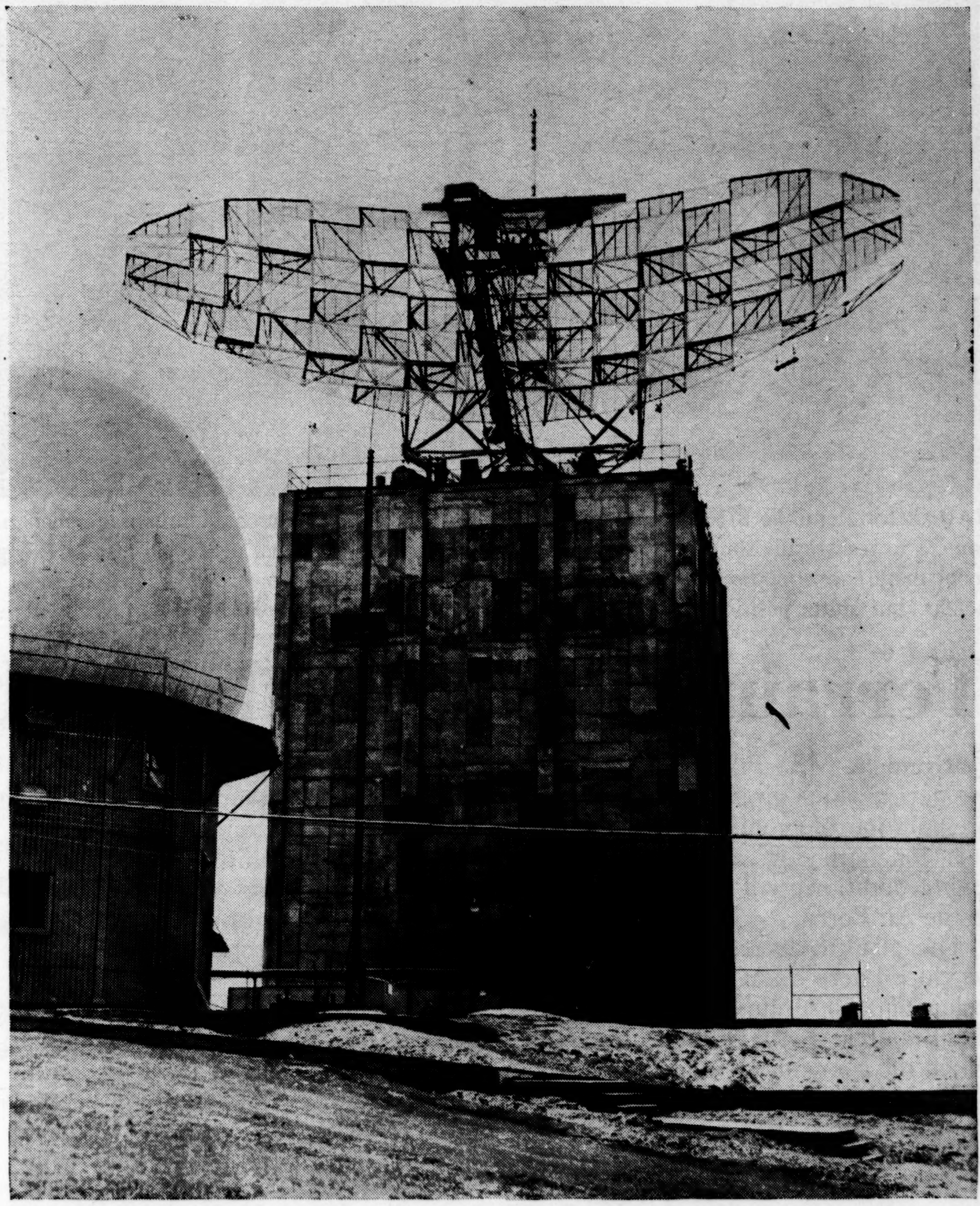
Several weeks ago Air Force outlined its requirements for a sun-powered optical Maser transmitter (AW Dec. 5, p. 92). Unlike the SOCOM system, this device would rely on the sun as a pump, or power, source for an optical Maser whose output would be the information carrier. Small contracts, probably less than $50,000 each, are expected for the sun-powered transmitter and a separate modulator development. Electro-Optical reportedly is one of the bidders.

SOCOM's transmitter consists of a lightweight mirror antenna system which collects the sun's rays and funnels them through an electromechanical modulator, then retransmits them from a second mirror system toward the receiver. Both mirror systems are Cassegrainian arrays (double mirrors with one focusing reflected light back through a hole in the other). These two dual mirror systems permit light to be picked up from one direction, resent in another. A solid-state radiation tracking transducer (AW Sept. 21, 1959, p. 79) mounted above the first mirror system acquires the radiation source (sun). The transmitter's antenna gain is 53 db.

At the receiving end, transmitted modulated signals are received by a glass parabolic mirror, reflected back against a second mirror in the Cassegrainian array and refocused through the aperture in the first. Signals are detected by a photomultiplier, conventionally processed and read out. The receiver's field of view is four minutes.

Total power required by the transmitter is roughly 10 watts, about equally split between modulator and transducer. Operational versions of SOCOM employing lighter mirrors in place of the glass arrays now used is expected to weigh between 30 and 40 lb., company engineers say. As part of a separate project, but applicable to SOCOM, the company fabricated a 5-ft. diameter mirror displaying high optical quality. Density of this mirror is 0.4 lb./ft.^{2}

While these field tests may establish the feasibility of sending and receiving light signals in space environments,



Air Defense Command Radar Site at Montauk, N. Y.

Sperry FPS 35 long-range surveillance radar antenna at USAF Air Defense Command's 773rd Radar Squadron, Montauk, N. Y., is 38-ft. high, 121-ft. wide and is mounted on an 85-ft. tower. This fixed primary search radar is part of Air Defense Command's frequency diversity program, designed to force an enemy to spread, and thereby weaken, his jamming power, or else necessitating an increase in enemy airborne ECM equipment. Installation is one of 170 frequency diversity radars planned to be operational by mid-1964.

they do not resolve the difficulty in locating a receiver (or acquiring a target)—regarded as a major stumbling block in this field (AW Dec. 14, 1959, p. 87). Because of the large distances over which such systems would operate in space and the narrowness of optical beams, some auxiliary acquisition techniques might be needed.

Among the several modulators evaluated during the field tests, the most promising, engineers here say, is a crystal analog of the Kerr cell. This is called a stressed plate shutter. The Kerr cell is one of several types of modulators suggested for optical communications (AW Feb. 22, p. 63). Normally, in the Kerr cell, a liquid—usually nitrobenzene—straddled by two electrodes is placed between two polaroids.

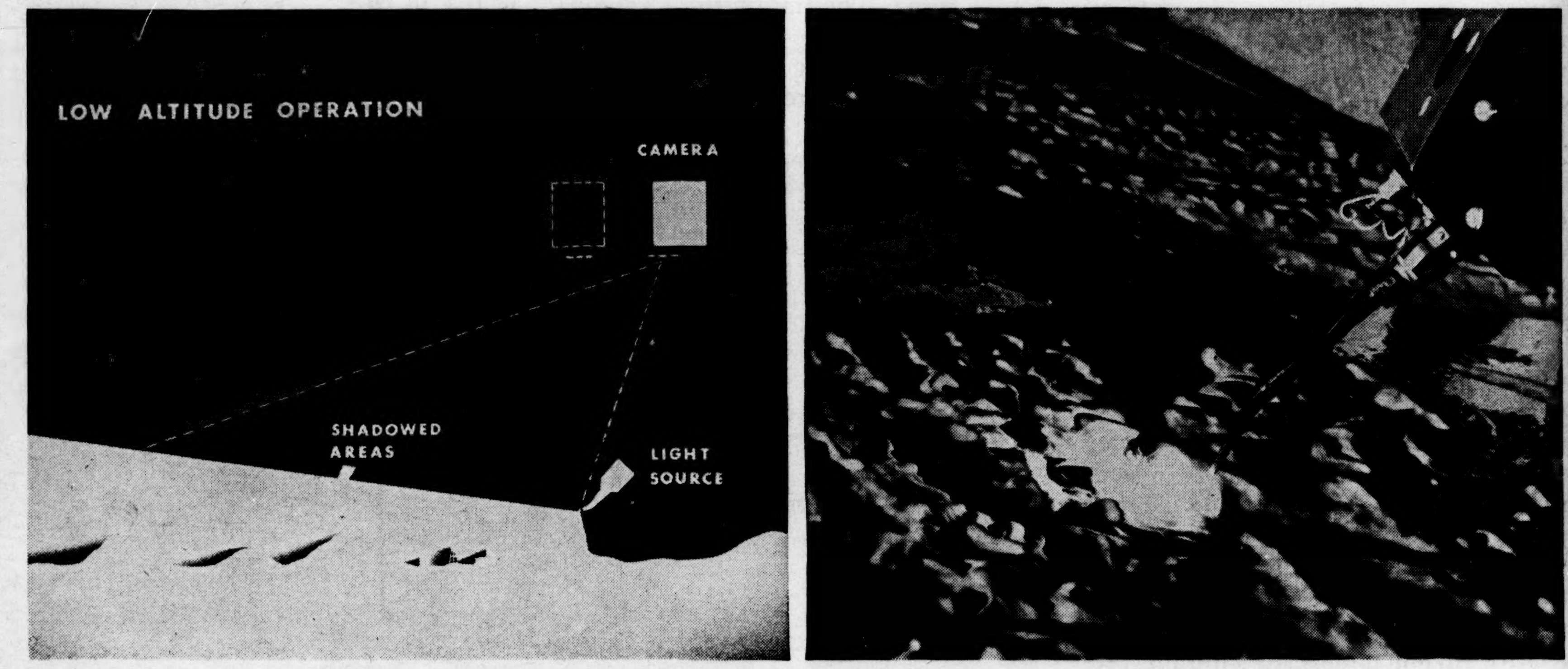
Axes of the polaroids are so aligned that light does not pass through them. Applying a potential across the electrodes changes the liquid's properties (alters plane of polarization) and permits light to pass as a function of the applied potential.

Compared with the Kerr cell, the stressed plate shutter, according to Electro-Optical, requires less voltage (by a factor of about 10), is more rugged and does not employ a toxic liquid.

A glass plate replaces the nitrobenzene in the stressed plate shutter. Necessary changes in the index of refraction of the glass are produced by stresses perpendicular to the direction of light passage. The result is a change in the plane of polarization.

The glass is cemented between two beams. Two barium titanate wafer stacks join the beam ends at right angles. As modulating voltages are applied to the stacks they expand or contract. Strains are transmitted through the stacks and the beams to the glass, producing a change in its index of refraction.

The SOCOM system probably will be delivered to the Communications Laboratory at WADD sometime after the first of the year although the delivery date is not yet firm.



RADAR for Republic F-105 simulator uses high intensity light source illuminating relief map of target area and a closed-circuit television camera to realistically simulate ground mapping radar operation at all altitudes, from tree-top level to 100,000 ft. Light source moves over relief map, corresponding to aircraft position, and moves up or down as aircraft altitude changes. Television camera does not change height, but shifts position and is inclined slightly for low-altitude operation. Light source illuminating map is shown at right.

Terrain Radar Simulator Uses Television

Riverdale, Md.—Pilot-navigator training device which gives a simulated radar presentation of ground terrain and targets for both low and high altitude flight conditions will soon be delivered to the Air Force.

The all-altitude radar simulator was developed here by ACF Electronics Division of ACF Industries for use with the Republic F-105D flight simulator which the company is building.

The ACF training device is a marked departure from previous radar simulators that used three-dimensional maps of the terrain placed under water in a large tank with an ultrasonic transducer to transmit sound waves through the water which were reflected back from the submerged model.

The new radar simulator also uses a 3-D model of the terrain to be simulated, but visible light and closed-circuit television have now been substituted for the more critical ultrasonic systems.

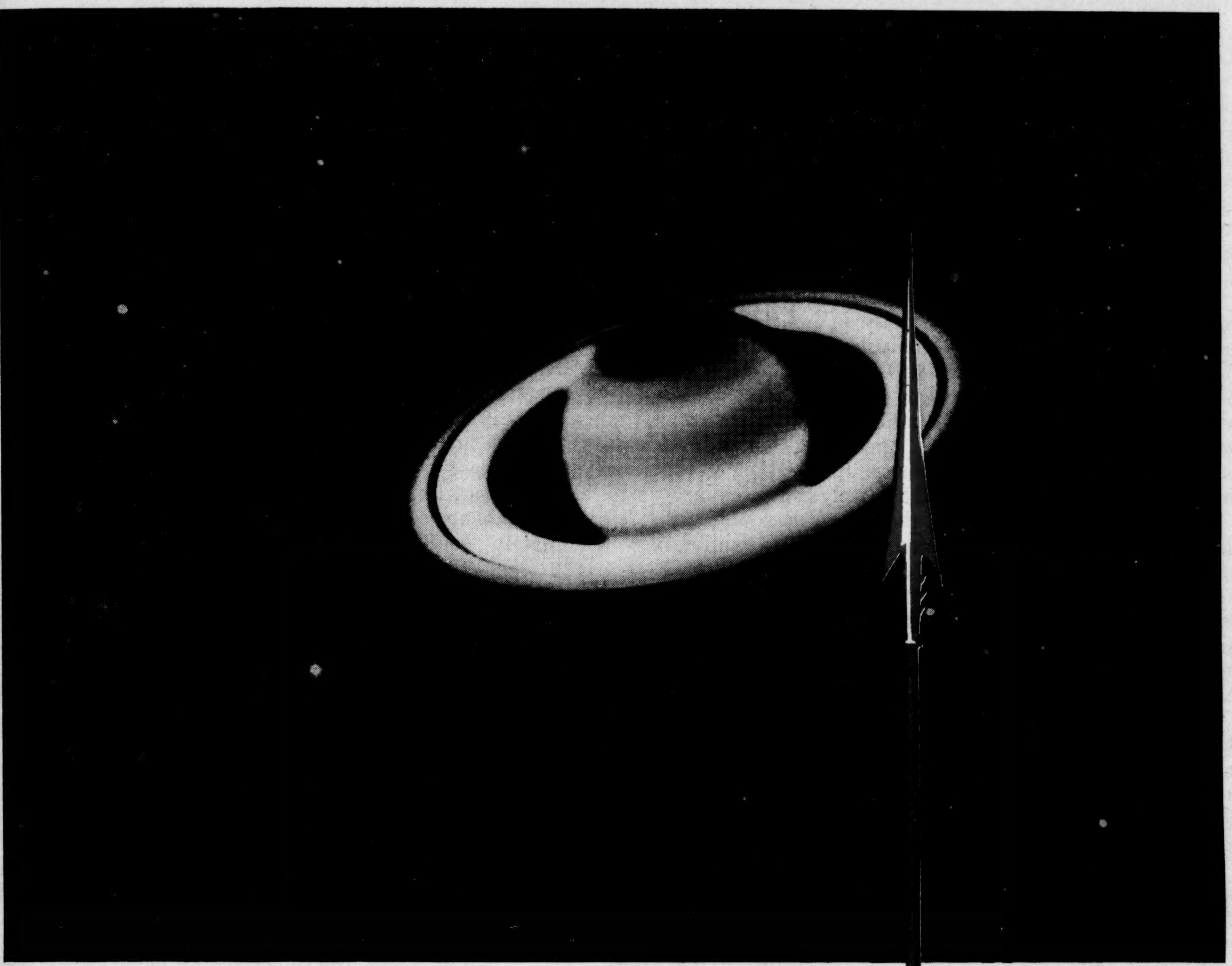
The 3-D terrain-target model is constructed to scale from plastic and then covered and/or painted so that terrain and targets on the model will reflect visible light proportionately to the real terrain/target reflection of radar energy.

To simulate ground clutter return, the hills and ground of the model are coated with powdered black carborundum, while rivers and lakes are painted black so they reflect no light. Concrete buildings and bridges are painted white, because they are strong radar signal reflectors, while weaker radar targets are painted grey.

The terrain-target model is illuminated by a high-intensity light source which moves on a gantry over the model so its position corresponds to the position of the simulated aircraft in flight, and the light source's height above the model corresponds to the simulated aircraft's altitude. The light source moves over the terrain-target model in synchronism with the simulated aircraft movement.

Illumination from the osram lamp in the light source passes through a four-inch-long synthetic sapphire rod, which tapers to 0.028 in. at its tip. This produces a light beam which is shaped somewhat like the cosecant-squared beam employed by airborne ground-mapping radars. The terrain-target model therefore is illuminated in much the same way as the actual terrain-target area would be from an airborne radar. For example, at high simulated aircraft altitudes, only the tallest mountains produce shadows, while at low simulated altitudes even small hills produce shadows.

The visible light reflected in varying degrees from different portions of the



SPEARHEAD INTO SPACE Created by Aerolab, the ARGO D-4 four-stage sounding rocket is now being used by NASA for the low-cost acquisition of important data at high altitudes and velocities. A wholly-owned subsidiary of Ryan Aeronautical Company, **Aerolab has developed more space probes and rocket-powered research models, including the Mercury capsule model, which have been fired, than any other firm in the United States.** Aerolab is a science team with quick reaction capabilities—a group of scientists and engineers with special talents for solving advanced problems in astrophysics, aerophysics and geophysics. Thus Aerolab's capabilities are added to Ryan's own in accomplishing breakthroughs in many vital areas of Space technology.

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model is viewed by a closed-circuit television camera, located on the gantry near the light source. Unlike the light source, the TV camera does not move vertically with respect to the model. However, when the aircraft simulator is flying at lower altitudes, the camera's longitudinal position is shifted closer to the light source and inclined slightly in the direction of flight to give more pronounced shadows.

The TV camera is scanned with a plan-position-indicator (PPI) type raster so that its cathode ray tube display in the simulator will have the familiar radar scope type presentation. A 90-deg. offset sector scan is employed which shows terrain 45 deg. on either side of the airplane's flight path.

Generally speaking, the model is an accurate miniature replica of the actual terrain and target area, except that special shaping may be used on certain types of targets, such as bridges, to assure that their radar image changes realistically with aircraft radar viewing angle and altitude.

To provide realistic operation, it is possible for the pilot flying the aircraft simulator to crack up on a mountain or other obstacle. To prevent damage to the light source and its sapphire light source probe under such a condition, a pressure-sensitive switch is built into the probe. If the probe touches the model relief map, the switch is actuated, stopping further movement of the light source probe and flashing a light in the aircraft simulator to advise the pilot that he has simulated a crash.

Terrain Clearance

The ACF radar simulator, like the North American Autonetics NASARR radar used on the F-105D, provides automatic terrain clearance warning. The pilot can select any desired "clearance plane" between his present aircraft altitude and the radar will show only those mountains, or other obstructions, which are above this selected altitude on the aircraft's radar scope. For example, if the aircraft is flying at 5,000 ft., and the pilot only wants to see any obstacles within 1,000 ft. of his airplane's altitude, the NASARR radar automatically displays on the radar scope all objects whose altitude is 4,000 ft. and higher.

The ACF radar simulator provides this mode of operation using a second non-relief type map in which terrain elevation contours are shown in black, white and various shades of grey. A second TV camera scans this second planar map in synchronism and registry with the previously described TV camera, automatically determining which portions of the relief map should be displayed on the radar scope because they exceed the critical altitude selected by the pilot.

The radar simulator has been flown by F-105D pilots. Some reported that its target resolution and detail were better than that being obtained in the F-105D, so ACF altered the range and azimuth resolution to make the simulation more realistic.

Simulator was developed under Wright Air Development Division sponsorship. The relief maps used in the simulator, produced by Aero Service Corp. of Philadelphia, are said to be strong, durable, and are designed to be easily altered to incorporate changes in a target area. The simulator is expected to go into use with the Tactical Air Command early this year.

Electronic Components Market Has Almost Tripled in 10 Years

Washington—First detailed survey of the electronic components industry, made by the Commerce Department's Business and Defense Services Administration, reveals that more than 40% of the industry's $3 billion output last year went into defense equipments or for maintenance of military equipments.

The BDSA survey indicates that the electronic components market has nearly tripled in the past decade, but that it is dominated by a relatively small number of firms.

For example, although there are 15 companies which produce receiving tubes, five of them account for nearly 85% of the total market. In the transistor field there are approximately 30 manufacturers, but three companies get more than 50% of the total industry sales. Tubes and semiconductors represent 44% of the total value of components produced in 1959, according to the BDSA survey.

Approximately 1,500 companies are now producing one or more types of electronic components. The vast majority are small companies. BDSA points out that electronic component production is less concentrated today than prior to World War II, when consumer products constituted the major market and a very few companies dominated the components field. "So long as the manufacture of highly complex weapon systems, characterized by rapid technological obsolescence and low production rates, continues to account for a major part of the total electronic equipment production, many producers of specialized, high-performance components will be needed," BDSA concludes.

Although many observers expected the semiconductor manufacturers to go through a period of shakeout in which the number of companies would be greatly reduced, in the pattern of the receiving tube industry some years ago, BDSA points out that no such tendency was apparent in the 1958-59 period which it surveyed.

The positions of individual firms shifted, but the over-all concentration of the market in the hands of a few producers actually decreased slightly, the survey indicates. BDSA's survey suggests that the market for high-volume semiconductors will be dominated by a few firms, while the production of specialized types will be distributed among numerous firms.

Three-quarters of the nation's output of components comes from seven states. Illinois heads the list with 12.4% of the total national output, followed by Pennsylvania with 12.3%, New Jersey with 11.9% and Massachusetts with 10.9%. The next three are California with 9.6%, New York with 9.0% and Indiana with 7.9% of the national total.

The electron tube and semiconductor segments of the industry are even more concentrated, with five states producing almost 75% of the national output. Pennsylvania alone produced 20%, but the semiconductor industry is expanding in the west, to California, Texas and more recently in Arizona.

The most recent data available on output per employe, based on 1956 figures, indicates an industry average of $9,100 per employe. Broken down by segment, these range from $6,800 per employe in capacitors to $14,700 per employe in TV picture tube manufacturing. Also based on 1956 figures, due to be updated next year, one out of every 20 employes in the component industry is an engineer or scientist. (This is lower than the ratio for electronic equipment manufacturing.)

Future Outlook

Although conventional components will be needed for many years for replacement parts and for use in consumer and other environments which do not require extreme miniaturization and/or reliability, the BDSA notes the possible impact of microminiaturization and molectronics on the industry.

"Equipment manufacturers will probably fabricate an increasing proportion of their component elements during the assembly process and components manufacturers will have to enter equipment manufacturing to the extent of providing complex component packages or more complex subassemblies.

"Many existing types of components may be supplanted by semiconductors and other devices that provide greater reliability along with reduced size and that permit automated fabrication. But the same equipment design trends will probably bring into being many new specialized components and these will continue to create and support component firms, both large and small," BDSA concludes.

A copy of the 18-page BDSA report, containing a variety of data on the electronic components industry and its output by type of component, can be obtained for 20¢ from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Ask for "Electronic Components, Production and Related Data, 1952-59."

Dyna-Soar to Utilize Fiber-Optic Monitors

Fiber optics fire hazard surveillance unit planned for Dyna-Soar will allow the pilot to look directly into compartments of the glider and the Titan booster where hazards exist.

The extreme reliability of such a device compared with conventional fire detectors will give the pilot a more certain indication of whether he should escape from the glider.

The fiber optical device would consist of a bundle of 0.002 in. diameter glass fibers.

Almost any bundle structure will serve for the detection of flame, but for a high quality image, the fibers must be carefully oriented. The Dyna-Soar engineering office at Wright Air Development Division is considering the use of fiber optical surveillance systems to detect fluid leaks, smoke and other hazards in remote parts of the vehicle. These systems would need higher quality images.

FILTER CENTER

▶ **BTL Pushes Satellites Program**—One indication of the steam that American Telephone & Telegraph Co. is putting behind its program to develop a commercial communications satellite is to be found in recent Bell Telephone Laboratories advertisements seeking engineers and scientists with backgrounds suitable for work in communication satellites. BTL seldom uses ads for recruiting, even during the past periods of critical engineer shortage.

▶ **Defense Sales Prediction**—Electronic Industries Assn. predicts that sales of military equipment in 1961 will be $5.3 billion, up 6% over current year's $5 billion which was a 6% increase over 1959. Military product sales made up more than half of the industry's total output this year. EIA President Berkley Davis says that despite optimistic outlook for the electronics industry as a whole, manufacturers face "extremely rough competition within the next few years . . . only manufacturers who keep abreast of the rapid technical developments in electronics will survive," Davis cautions.

▶ **New Name Proposed for PGANE**—IRE's Professional Group on Aeronautical and Navigational Electronics will substitute "Aerospace" for "Aeronautical" if its members approve proposed change. This change is intended to reflect PGANE's interest in electronics used for operation, control and navigation of spacecraft. Effort to merge PGANE with IRE's Professional Group on Space Electronics and Telemetry (PGSET) has been dropped because of lack of PGSET interest.

▶ **Military Components Forecast Due in Italy**—Defense Department's Electronics Production Resources Agency is preparing a five-year forecast of military component needs for 13 categories of components which is scheduled to be published next July. Forecast will cover three types of batteries, seven capacitors, seven resistors, all types of transformers and reactors, five electrical indicating instruments, three relay types, three quartz crystals and filters, four receiving tube types, 13 power tubes, four semiconductor diodes/rectifiers, two transistors and all types of connectors and servo devices. Some of these components also will be reported on an 18-month projection basis, starting in January, 1962.

▶ **NBS Develops Low-Temperature Bonding**—National Bureau of Standards has developed techniques for attaching wires to heat-sensitive devices, such as transistors, and to cold-solder ceramic and metallic surfaces, using gallium alloys as the bonding material. These alloys are soft when mixed at room temperature but after hardening can resist temperatures as high as 900C. These alloys originally were studied by NBS for possible use in dental restorations but were abandoned when it was found that they were tarnished by food. Details are contained in NBS Summary Technical Report No. 2538, available from NBS Office of Technical Information, Washington 25, D. C.

▶ **Soviets Expanding Solid State Physics**—Russian research in solid state physics is growing so rapidly that the number of Soviet publications in this field is expected to surpass that of the United States in five to 10 years, according to a study made by a U. S. government agency. The study praises the Soviet's excellent theoretical research in solid state physics. It says that Russian scientists are better informed about U. S. efforts than their U. S. counterparts are of Soviet work. The report confirms observations of some U. S. visitors that there is less cooperation between Soviet theoretical and experimental workers than in the United States. Copy of the three-page report, "Soviet Solid State Physics," No. 60-21923, may be ordered for 50¢ from Office of Technical Services, Commerce Dept., Washington 25, D. C.

▶ **Navy Drafts Moon for Service**—Navy's moon-bounce relay communication system, used for experimental and part-time communications between Washington and Hawaii, was pressed into full operational service during recent magnetic storm which blacked out normal HF radio communications.

▶ **Signed on the Dotted Line**—Major contracts recently announced by avionics manufacturers include:

- **Electro-Mechanical Research, Inc.,** Sarasota, Fla., a combined study-design contract for speech bandwidth compression from Rome Air Development Center. Contract includes studies to determine relationship between intelligibility and voice quality with sampling rate, corner frequencies and signal-to-noise ratio and construction of an equipment for evaluating such parameters.
- **Electronic Assistance Corp.,** Red Bank, N. J., $1.1 million contract for manufacture of radar altimeters of two types, one for high altitude operation and the other for low-altitude helicopter use.
- **Electronic Associates, Inc.,** Long Branch, N. J., contract from Sperry Gyroscope Co. to produce a large-scale, three-console analog computer for use in a Polaris submarine simulator.
- **Remington Rand Univac,** St. Paul, $338,000 award from Boeing Airplane Co. for antenna couplers to be used on 707 jetliners.
- **Marconi Wireless Telegraph Co.,** $1.8 million contract from British Ministry of Aviation for doppler navigator and automatic direction finding equipment for use on the Armstrong Whitworth Argosy MK. 1 to be operated by Royal Air Force.
- **Hoffman Electronics Corp.,** $350,000 contract for Tacan beacon simulators for the United Kingdom.
- **Collins Radio Co.,** Cedar Rapids, $1.5 million Air Materiel Command contract for AN/ARC-58 single sideband communication sets to be used on B-52 and KC-135 aircraft. Also, $1.3 million AMC contract for VHF communication and VOR navigation sets. Company also reports $626,028 award from McDonnell Aircraft Corp. for navigation instruments to be used on F4H-1 fighter.

FINANCIAL

Gen. Irvine Urges Faster Economic Growth

Projections for an increase in U.S. gross national product to a rate of 7% by 1970 or a total of $850 billion and an accompanying rise in national security expenditures to more than $60 billion are part of an economic study made by Lt. Gen. C. S. Irvine (USAF Ret.), now Avco Corp. vice president-engineering and planning, for the University of California at Los Angeles. Excerpts from the assumptions and analysis on which these projections are based follow. Fourteen paragraphs which constitute the heart of this study, with accompanying notes, are on succeeding pages.

At the present time it is obvious that the Sino-Soviet bloc is matching us in over-all military capability. The Russians are certainly exceeding our progress in space exploration. Beyond any question they are building up their basic war industries and related heavy industry at a much greater rate than we are. In summation of their military potential, it becomes crystal clear that with only about half of our gross national product, they are matching our military program, therefore, they are devoting twice the percentage of their resources than we are of their total national product to military purposes.

Our problem in dealing with the Soviet is intensified by the fact that their total economy is growing at a faster rate than ours. If they continue to devote anything approaching present percentages of their national product to military purposes, it is obvious that their military posture will become superior, and in the end their long-range threat to our security will become overpowering. This spells Soviet domination and victory without war.

Emergence of China

The military emergence of Communist China was clearly demonstrated to those who participated in the bitter and costly operations of the Korean War. In the 1965-1975 time period, there is no question that China can offer a much more serious threat to us than Russia. In the first place China has approximately three times as many people, and in the second place China has a much more ruthless dictatorship.

There is one clear lesson to be learned from a careful study of the past activities and the stated future objectives of the Soviet-Chinese bloc.

A long-range national plan of industrialization carried out with a complete disregard of human rights by a dictatorship will bring results. In most cases the Communists have not fully met all of their objectives, but they have made progress at a greater rate than any other country in the history of the world. From the depths of human misery and industrial and agricultural slavery, they have made very real progress and very real accomplishments. They have shown amazing results not only in simple sectors of housing and essential transportation, but in the fields of science, in the fields of automation, and finally in the areas of manufacturing and production as well. . . .

. . . While the strong nations of the Free World have collectively worked together in NATO and SEATO, as well as United Nations, they have not been really aggressive or closely cooperative. In the face of the strong and united onrush of international communism, the Free World had shown weakness, indecision, selfish isolationism, and narrow nationalism.

The progress of our democratic free enterprise system in the last 50 years has been dynamic and tremendous. However, too many of us have become so satisfied with our own success that we have failed to observe what the other players on the world's scene have accomplished in the same time period. Almost everything that we have done in the last 50 years has been outdone by the Soviets starting from a much lower level of knowledge, training, education, and experience. . . .

We do not publicize, as a general rule, our long-range national planning in the United States. However, we do have planning groups within our government whose work is highly classified. There have been sporadic attempts to bring in people, on a committee basis at various levels of government, to do forward planning.

It now becomes obvious with the present progressive status of the Soviet and the upcoming surge of the Chinese, that we should plan for military readiness, economic warfare, and spiritual combat for the next 50 years in this country.

Outstanding work was done by W. H. Draper, with his presidential committee on U. S. military assistance. Of particular merit were the recommendations of the national goals the U.S. should establish. The Gaither Report, the Rockefeller Report, Massachusetts Institute of Technology studies, and university studies by Harvard and UCLA, all point to the absolute necessity for thorough long-range national planning. The only trouble with the majority of these reports is that they have been so highly classified that people in government and industry who might find their contents useful have been unable to obtain access to them or utilize them accordingly for constructive action. . . .

Long-Range Planning

. . . The very foundation of the determination of the amount of our gross national product that should be devoted to our defense on a percentage basis or on a total dollar basis is the creation of a national plan. This planning should be done in accordance with the recommendations of a reasonable permanent organization which would be part of the top management of our government.

Men of the caliber of Draper, Cordiner, or Rockefeller could be obtained for this type of work. It must be established on a basis of continuity with each succeeding administration. A minimum of a four-year tour with, of course, occasional replacements for those who are separated for personal reasons. . . .

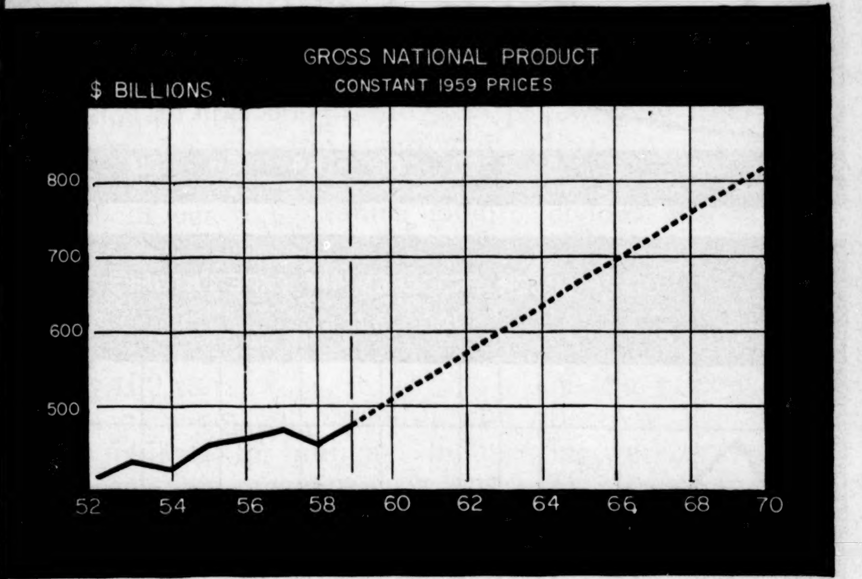
It is essential that we establish within the framework of our government, as a part of the office of the President, a group of elder statesmen, of the business management variety, who understand the sound and proper business management of our total resources. This group would plan for the best utilization and expansion of power, transportation systems, manufacturing resources, natural resources and finally and most important, the sound management of our scientific and engineering capabilities.

It would be the responsibility of this group, together with our political management to ensure the early creation of an up-to-date long-range economic and military plan for the United States and our allies in the Western world. The procedures by which such a plan would be implemented and kept up to date would best come from the recommendations of a group which includes experience in both political and business management.

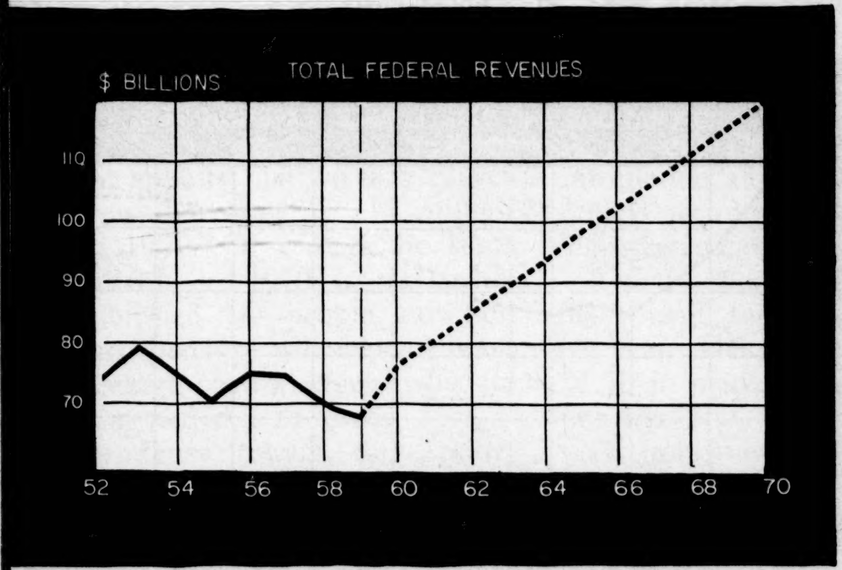
The Secretary of Defense should be reinforced by a permanent board consisting of three groups of people. The first group would include personnel to be drawn from our senior Army, Navy and Air Force officers, the second group would include senior business executives, and the third, outstanding scientists. Our best military advice and planning comes from those men of

Graphs Project National Defense Costs as Related to GNP

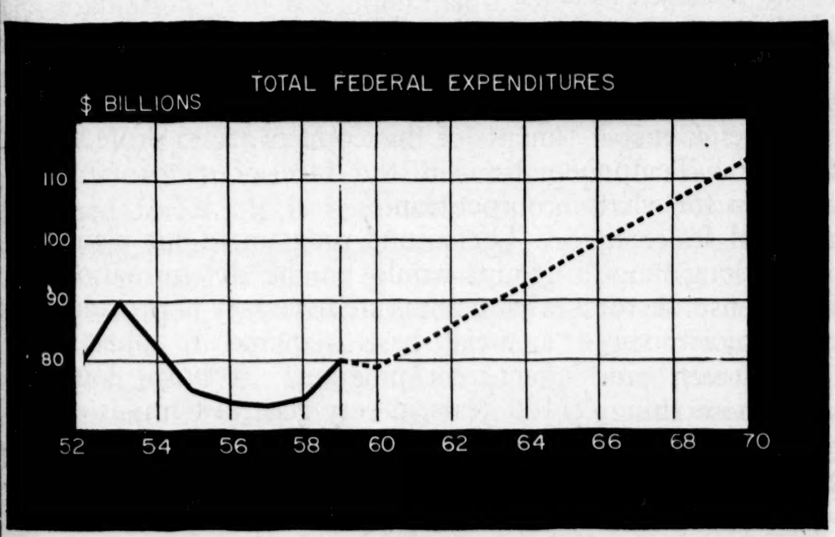
Fourteen charts covering Gen. Irvine's projections of gross national product and various facets of federal spending related to it are reproduced on the following page. Gen. Irvine's comments, accompany each chart.



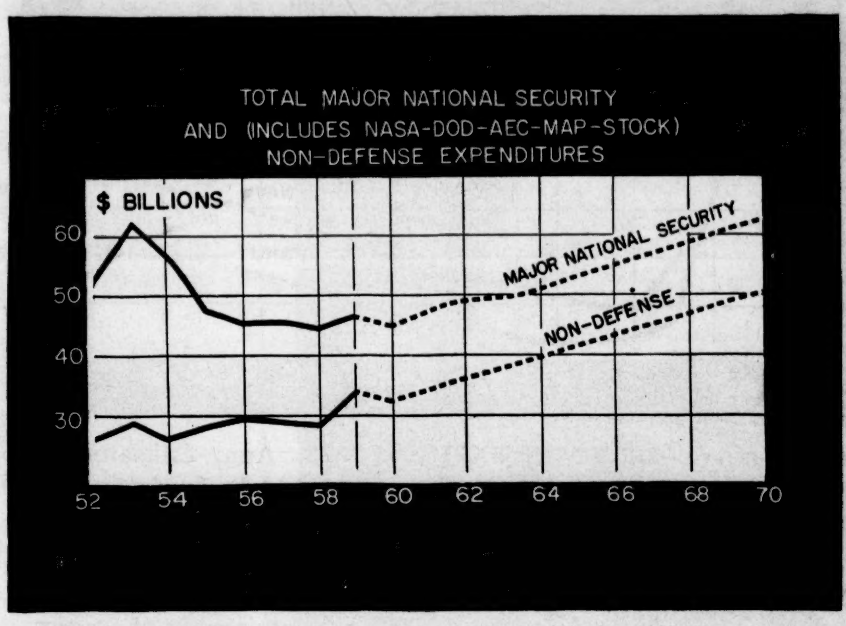
GROSS NATIONAL PRODUCT. Based on the assumptions in Irvine's study, the growth rate of 3% for the past 50 years should rise to 5% on a conservative basis and with effective action could be raised to 6% by 1965 and 7% by 1970 to reach a total of $850 billion.



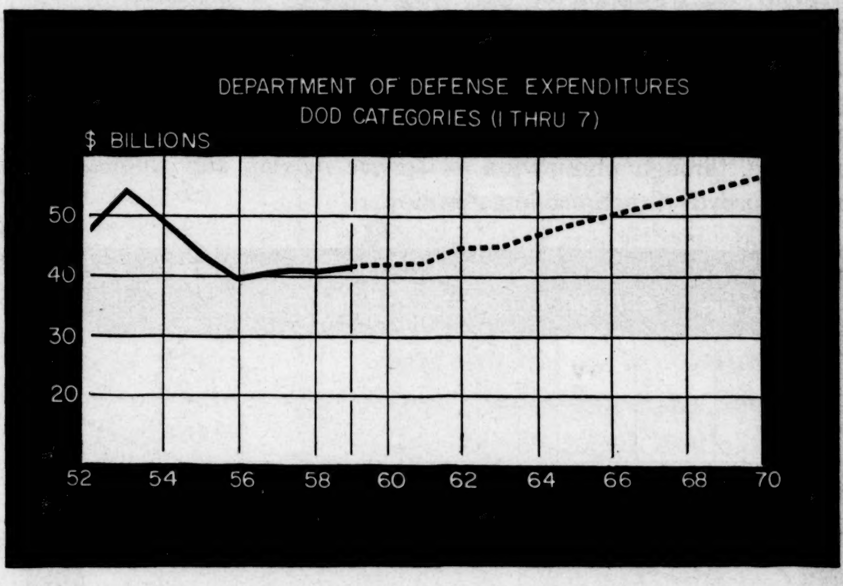
TOTAL FEDERAL REVENUES. These are projected to increase at 4%, allowing for a degree of leveling off in federal expenditures and for an increase in state and local taxation.



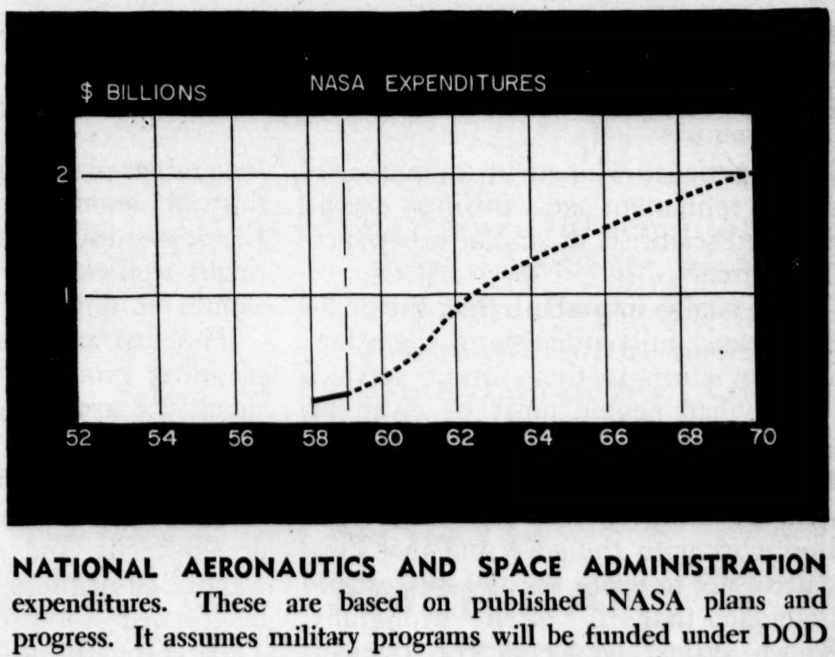
TOTAL FEDERAL EXPENDITURES. Projected at an increase of 3.8% a year, this would permit a gradual reduction in national debt.



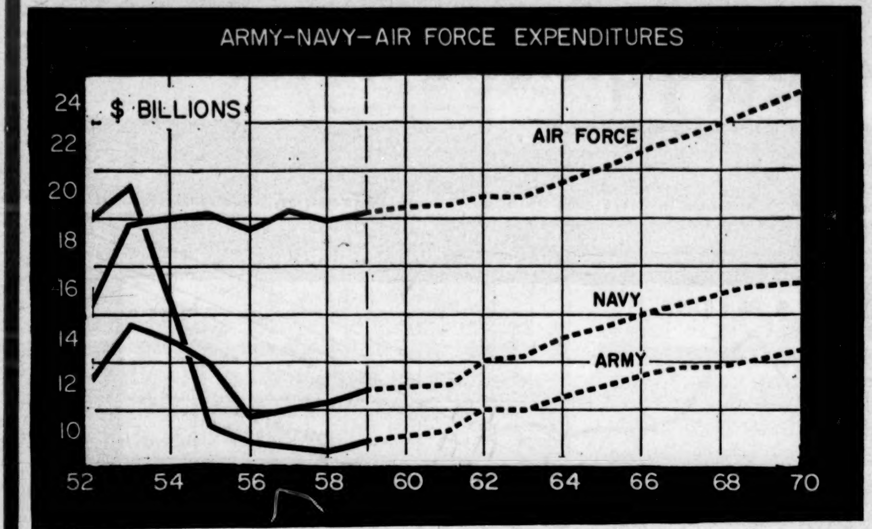
TOTAL MAJOR national security and non-defense expenditures. Based on a decline from 9% of gross national product in 1960 to 7.5% in 1970, this projection is considered a bare minimum of what may be necessary to meet Communist aggressiveness. Increased nondefense expenditures are programed to care for an expanding population and to protect and ensure adequate growth of the economy.



DEPARTMENT OF DEFENSE. This is a total of expenditures estimated and the minimum necessary for Army, Navy, Air Force, DOD functions.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION expenditures. These are based on published NASA plans and progress. It assumes military programs will be funded under DOD functions as they reach prototype or semi-operational stage.



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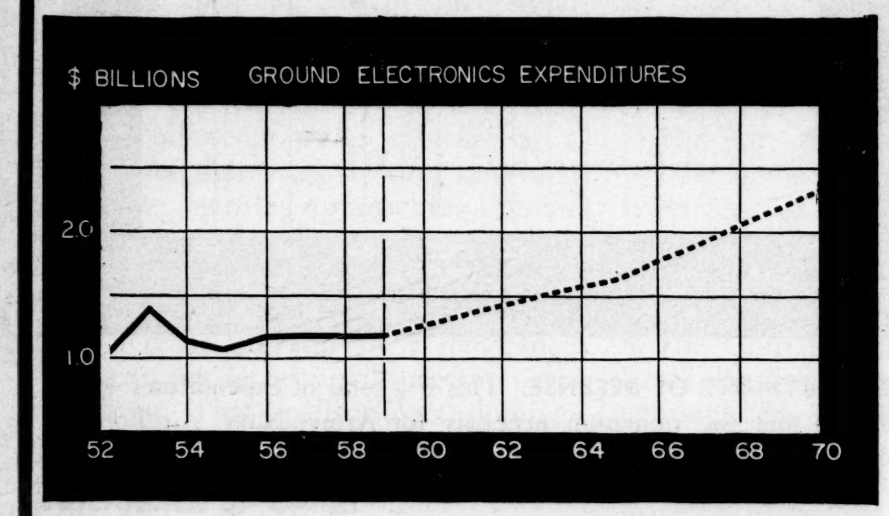

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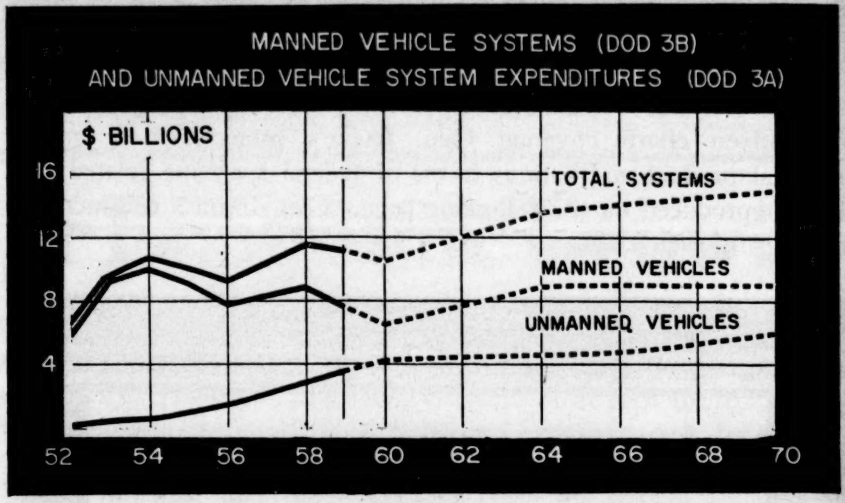
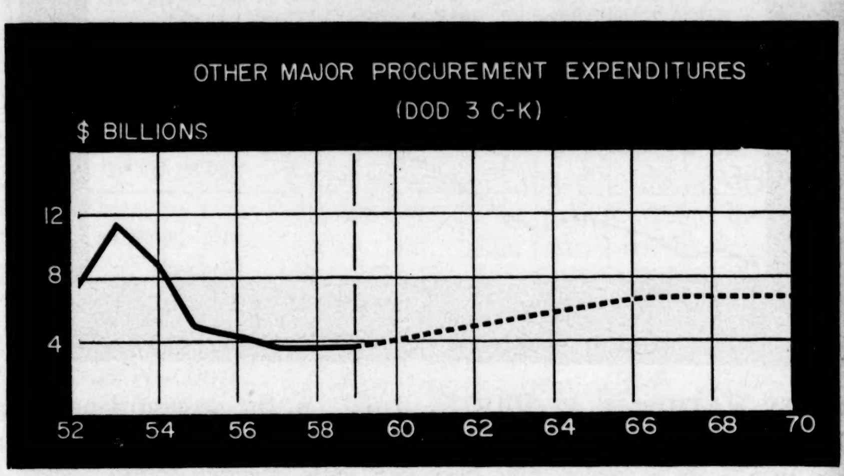
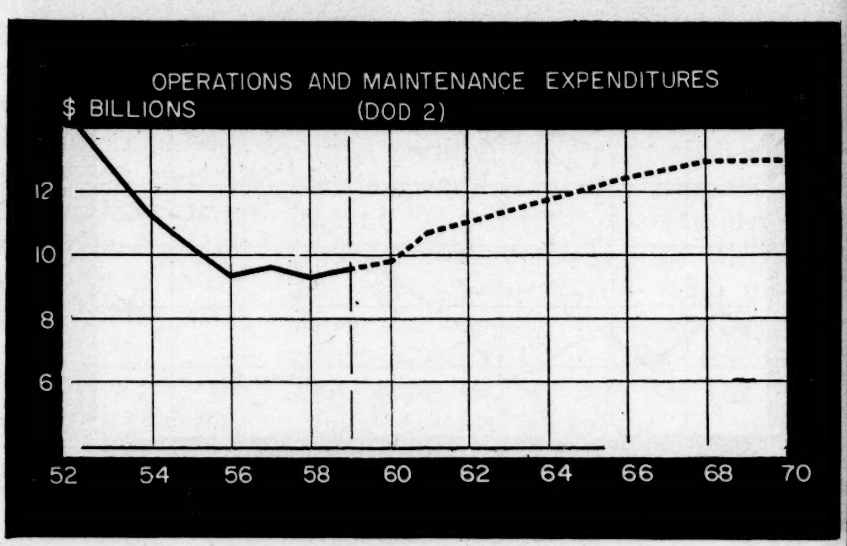




MANNED AND UNMANNED vehicle systems (above, top) and other major procurement expenditures (above, bottom). These two charts include the systems which make up that portion of the Army-Navy-Air Force expenditures chart.



OPERATIONS AND MAINTENANCE. The many new systems coming into being produce a rising curve into 1968. Diligent effort will be needed to hold these costs in line, including scrapping of old fashioned facilities.

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Central planning and establishment of broad policies for military, industrial and economic programs on a long-range national scope is essential to progress. The tendency toward the expansion of governmental bureaucracy into a strait jacket of centralized socialism must be avoided at all cost.

Population Factor

If we are to assume the next decade to be one of reasonably full employment, we should not expect population estimates to be relatively reliable. In checking authorities such as the Bureau of the Census and the projections of some of the senior economists of the country, it appears that we may expect to have on the order of 215 million people in 1970. Of course, the labor force available in 1970 is reasonably well established by people now on board, and therefore will depend upon the percentage of work force who are both willing and able to work.

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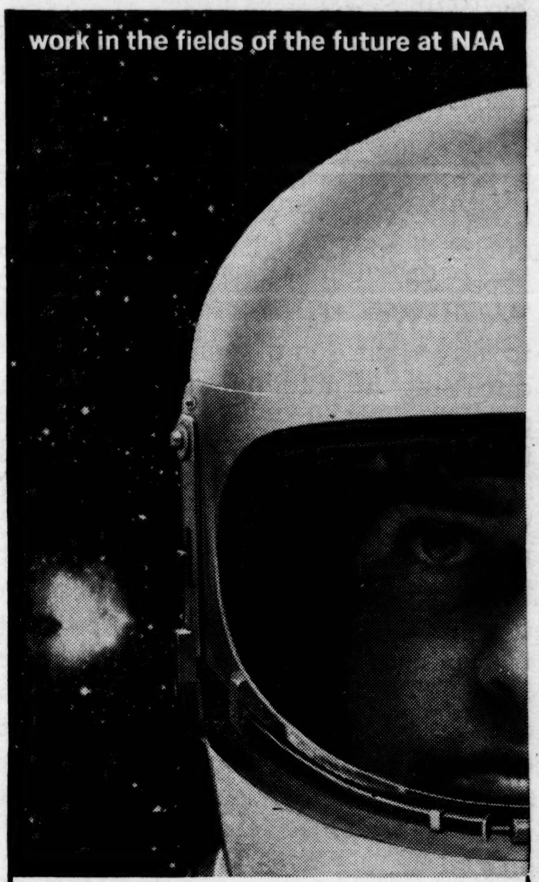
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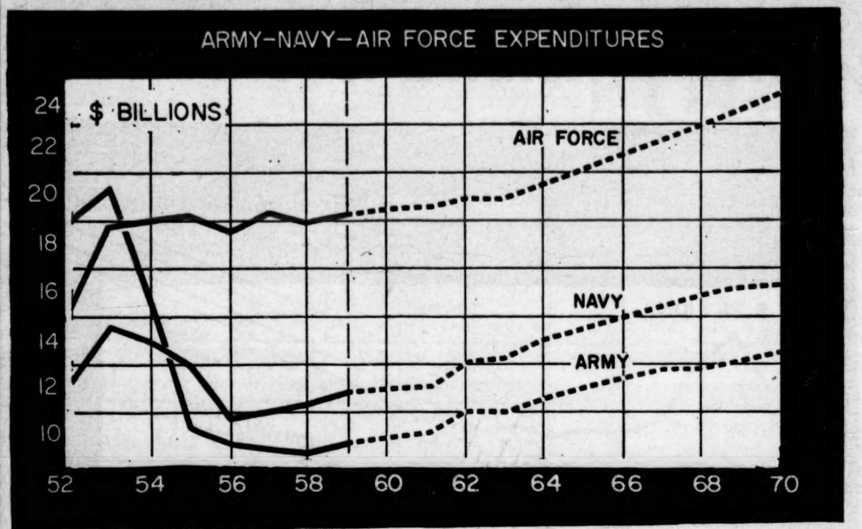

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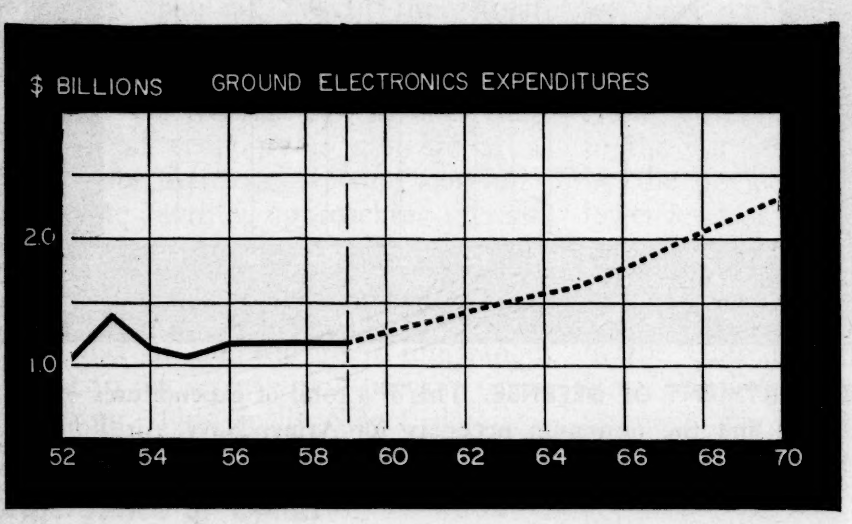

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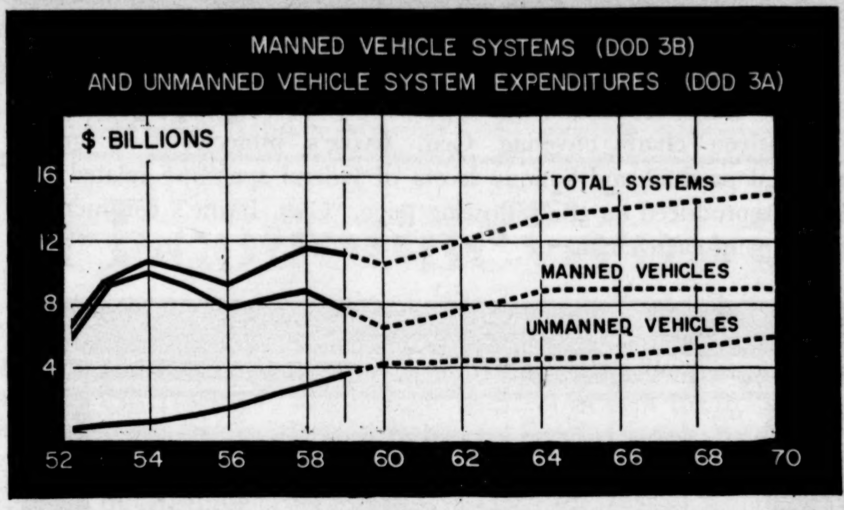

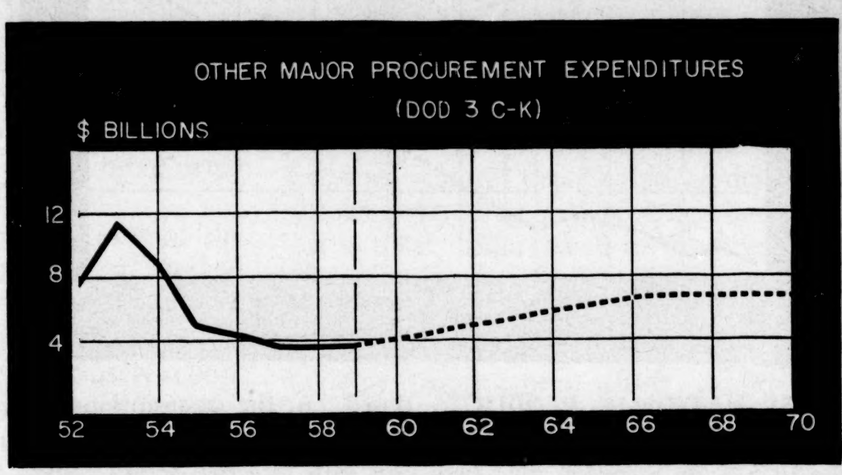

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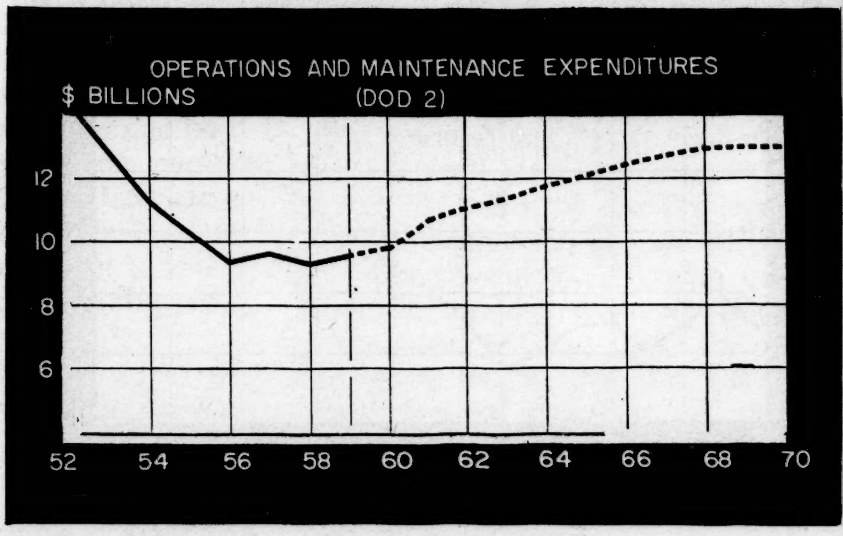

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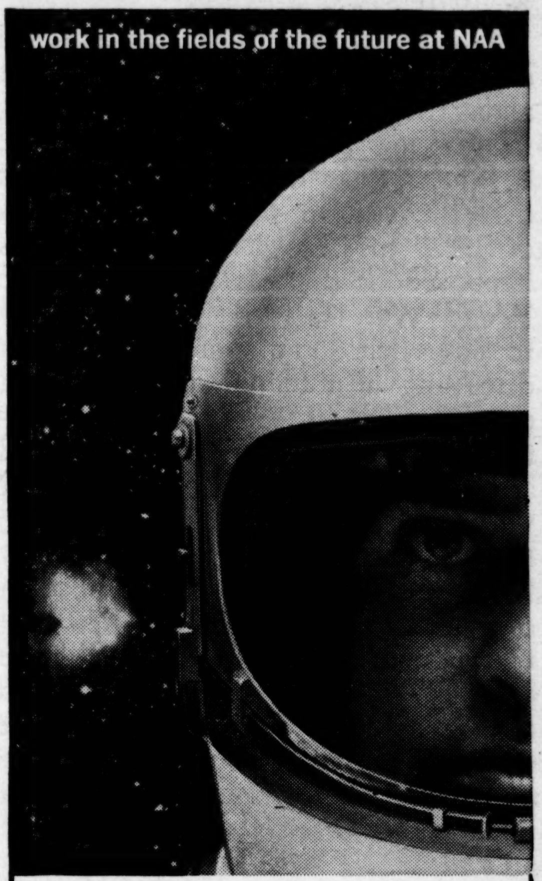
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gross national product of $850 billion by 1970. . . .

Projections by authorities of national eminence of our gross national product across the period 1960 to 1970 vary from a low of 3% increase per year, based on what has actually happened over the last 50 years, to projections of 3.2% to 4.2% based on what has happened in the last few years since World War II. It is interesting here to note that some sources have been discussing a potential annual growth on the order of 4% while other authoritative economists have considered a possible growth of at least 5% per year.

The importance of growth rates may be clarified if we consider the position of Khrushchev. He said in 1959 that the planned Soviet economy, while only 40 years old, is already able to challenge our 150-year-old capitalist state in economic competition in many areas, and is outstripping us in areas they choose to select such as the space area . .

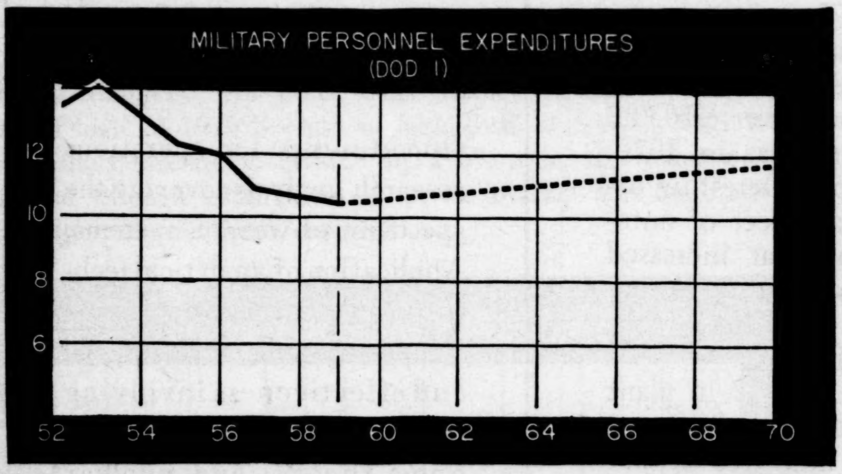
I am sure the Russian projections are based on the fact that they are looking at an average growth rate of the U.S. of around 4% in the 1960-1970 time period with a projected average growth rate of the Soviet across the same period of better than 6%.

Probable Utilization

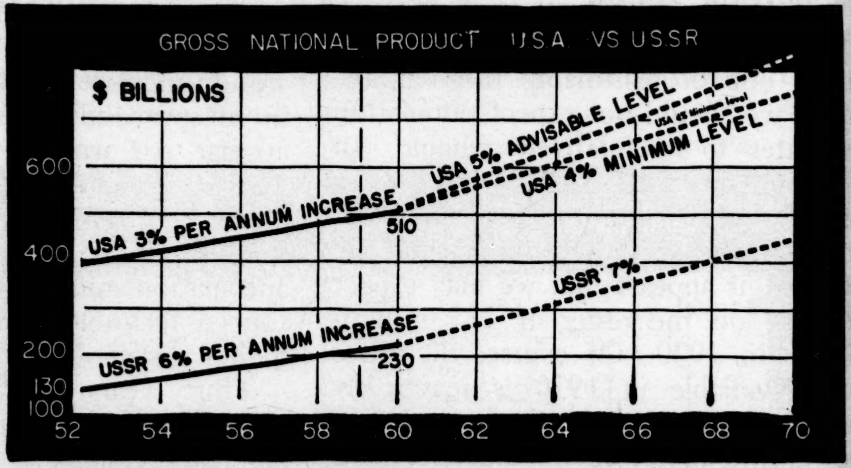
At the same time, the Russian is looking at a probable utilization of 9% at present reducing to about 5% in the future of our gross national product by the expenditures. In his own projection the Soviets devote on the order of 15% to their security program. Obviously, if this is done on the basis of conservative projections of their own, they will tend to plan to spend more for national security than we do in the period 1965 to 1970.

Since our total national production is still more than twice that of the Russians, we are still in a position to take the action necessary to maintain our superiority, both in the economic and military areas. This can be done, however, only if we concentrate our efforts, on maximizing the capability of our system.

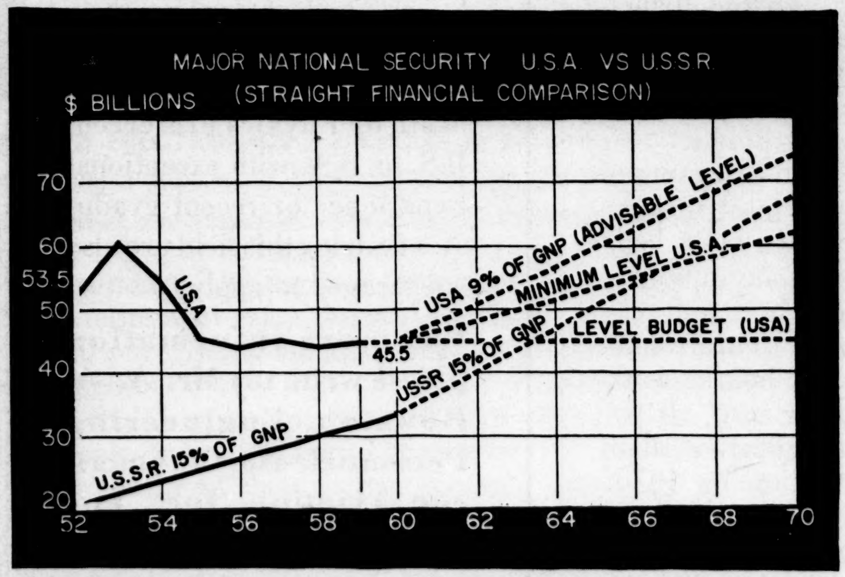
This projection shows on the order of $825 billion by 1970. This is conservative compared with what we could really accomplish. It appears logical that if we really go to work on this job on a national and an individual basis we could create $850 billion in gross national product in 10 years. Certainly we cannot ever afford to be in a position where the Soviet military programs exceed our own in quality and effectiveness. Certainly we cannot afford on a national or an international basis to permit their efforts, and more importantly, their results in space exploration to be greater than ours. These targets can be easily met by using 10% of our expanded gross national product. It is obvious that the present expenditure rate of about 9% of gross national product for defense and 10% for nondefense has not affected our national economy because our scale of wages, our scale of living, the standard of liv-



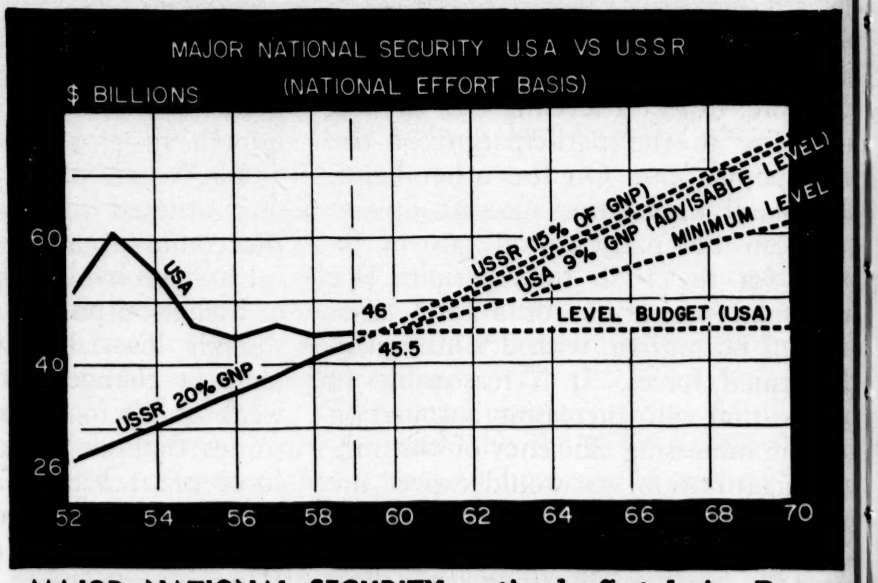
MILITARY PERSONNEL. By eliminating duplicatory jobs and eliminating all but essential headquarters, military manpower could be reduced from 2.5 to 2.1 million by 1970. This job must be done soon or the U.S. will be encumbered by red tape and taxes and have a military machine not respected by its enemies.



GROSS NATIONAL PRODUCT: U.S. vs. USSR. Performance of the U. S. at 4% annually against the Russian increase at 7% a year leaves the U. S. gross national product twice that of Russia's in 1970. But in 1950 the U. S. gross national product was four times Russia's.



MAJOR NATIONAL SECURITY: U. S. vs. USSR. If Russia continues its 15% of gross national product spending on defense, the U. S. can outdistance Russia if it maintains its present 9% rate. The minimum level of U. S. increase—7.5%—will be sufficient only if Russia diverts a larger portion of its gross national product from military expenditures. Under any circumstances continuation of a constant level of defense expenditures will be national suicide.



MAJOR NATIONAL SECURITY, national effort basis. Because comparisons in the preceding chart may be misleading, they are made here on a national effort basis. It is estimated that the equivalent of at least 20% of the Soviet gross national product is devoted to national security, or $46 billion in 1960. Reducing Soviet effort to 15% from 1960 to 1970 results in a total of $75 billion in 1970, paralleling the U. S. 9% of GNP projection.

ing of all our people has increased annually at a much greater rate than the gross national product itself. I think most economists agree that we could spend up to 15% of gross national product for the defense sectors of our economy without harmful effect.

The importance of our establishing effective long-range targets and long-range plans is that such a procedure well advertised on an international basis will provide a challenge to our allies and a warning to our enemies. The growing economic and political strength of our allies will enable them to assume an increasing portion of their own defense burdens. They can also expand their roles in assisting in the promotion of the economic development of the underdeveloped countries. Thus can be provided an incentive for the "have nots" to reach for the democratic system of government and the free enterprise system of management of industry.

We can stand firm against the present Soviet threat and the future threat from China if we really have the desire to as a nation, and if we plan for this sort of action. However, there are some things we must do. We must be willing to shift emphasis in the utilization of our resources, to work long enough hours to produce tangible results in quality and quantity of material. We must be willing to pay more taxes, if necessary, to regain the lead in defense and space exploration, to establish a truly higher level of education of our children, and to maintain the scientific leadership of the world.

New Offerings

Hydromatics, Inc., Bloomfield, N. J., engaged in the design, manufacture and sale of ball valves. Offering is (1) $1,000,000 of debentures due Jan. 1, 1971, and warrants to purchase shares of common stock of the company prior to Jan. 1, 1971, the debentures and warrants to be offered in units consisting of a $1,000 debenture and one warrant, and (2) 20,000 shares of outstanding common stock by the holders thereof. Public offering price of the debentures and warrants, terms of the warrants, and the underwriting terms to be supplied by amendment; public offering price of the common stock will be a fixed price determined by the selling stockholders and the underwriters. Offering also includes an additional $200,000 principal amount of debentures, with warrants attached, which are being offered by the company, at the public offering price less the underwriting discount, to directors, officers, and employes of the company, et al, who have indicated an interest in the company's affairs. Proceeds of the sale of the units of debentures and warrants will be used to retire bank borrowings which were used to pay for leasehold improvements at the company's new Bloomfield, N. J., plant; to purchase additional machinery and equipment during the next twelve months; the balance to be added to working capital.

Electronic Tube Corp., Philadelphia, Pa., engaged in the design, manufacture and sale of single gun and multiple gun cathode ray tubes, single channel and multiple channel cathode ray tube oscilloscopes, and associated electronic devices, for use in the aircraft, missile, ballistic and other industries requiring testing of electronic data. Offering is 100,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $100,000 will be used to acquire equipment and to begin production of high resolution magnetic tubes and cathode ray storage tubes; $50,000 will be used in the oscilloscope division and applied toward the purchase of equipment and components for the development of new specialized types of multi-channel cathode ray tube oscilloscopes; $66,300 to repay existing indebtedness to Kenneth C. Meinken, Sr., president, and $25,000 to repay a loan to Helen M. Richards, his sister; the balance to be added to working capital and used for general corporate purposes.

PneumoDynamics Corp., Cleveland, Ohio, organized under Delaware law in August, 1959. In September, 1960, the company acquired the assets of four divisions and one subsidiary of Cleveland Pneumatic Industries, Inc.; in exchange for such properties and businesses the company assumed certain liabilities of the acquired divisions and $1,891,000 of CPI's V-Loan indebtedness and issued to CPI 375,000 shares of common stock and its 6% 10 year debenture in the principal amount of $1,500,000. Approximately 80% of the company's business is with the government, primarily as a defense contractor supplying products and services involving advanced technology and requiring, in many instances, micro-precision manufacturing facilities capable of production to tolerances of one-millionth of an inch or less.

Offering is 175,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to pay the unpaid balance of the V-Loan indebtedness of CPI; the balance will be added to working capital.

Anelex Corp., Boston, Mass., engaged in the design, development and manufacture of high speed printers and high speed paper tape readers for use in association with computers and electronic data processing equipment or systems; it is also engaged in research, development, and the manufacture of other electronic and electromechanical systems and equipment. Offering is 65,000 shares of common stock. Of such stock, 55,000 shares are subject to purchase upon the exercise of warrants, of which 45,000 were issued attached to $2,250,000 of 5½% subordinated debentures at the rate of one warrant for each $50 of debentures and 10,000 were issued to Putnam & Co., Inc.; the 55,000 shares were registered effective Jan. 5, 1960, under the Securities Act of 1933. The remaining 10,000 shares are owned by Anderson-Nichols & Company and are subject to purchase by three individuals to whom options have been granted for purchase at $7.50 per share. The 55,000 warrants are exercisable at $16 per share to and including Dec. 31, 1961, and at $17.50 a share thereafter until their expiration. Proceeds from the sale of stock pursuant to the exercise of the warrants will be added to the company's working capital.

Shinn Industries, Ind., Wilmington, Dela.; the company was organized in November, 1960, to acquire all the issued and outstanding shares of capital stock of Shinn Engineering, Inc., a California corporation organized in 1952, and Universal Ecsco Corp., a Delaware corporation organized in April, 1960. All of the outstanding shares of the subsidiaries were acquired in November, 1960, in exchange for a total of 296,500 shares of common stock of the company. Through its subsidiaries, the company is now engaged in the manufacture, assembly and sale of aircraft and missile components on a subcontract basis, primarily for defense purposes, and in the design, engineering, manufacture and installation and/or erection of industrial and research facilities and equipment, and in fully packaged automated systems. Offering is 150,000 shares of common stock for public sale at $6 per share. Also, the company will issue to the principal underwriter 30,000 immediately transferable warrants, at 1¢ each, entitling the holder thereof to purchase from the company one share of common stock at $6.60 per share and at prices increased 60¢ per annum thereafter for five years; the underwriter plans to offer 1,500 of such shares to the public following the completion of this offering at the prevailing market price.

Of the proceeds from the sale of the 150,000 shares of common stock, $200,000 will be used to discharge a bank loan evidenced by a note issued by Ecsco, the proceeds of which were used to discharge payroll and withholding tax delinquency and other current liabilities of Ecsco; $225,000 to expand the manufacturing capabilities of Shinn; $150,000 to obtain the necessary tooling, advertising, and inventory buildup necessary to ready a new product, the "Morrisey plane," for marketing; the balance for working capital.

Altamil Corp., El Sequndo, Calif., engaged in the manufacture and sale of large machined structural components and stainless steel honeycomb sandwich panels for use in high speed military and commercial aircraft and missiles. The company was incorporated in California in June 1956. In 1957 the El Segundo Sales Co., Inc., and Aluminum Taper Milling Co., Inc., California corporations, were merged into the company; Thermo Form Co., Inc., also a California corporation, was merged into the company in 1959. On Aug. 31, 1959, the company acquired the Twigg Industries Division of Pryor Manufacturing Co. During May 1960 the company purchased all the outstanding capital stock of Aluminum Forge Co., a California corporation.

Offering is 251,716 outstanding shares of common, for public sale by the present holders thereof. Prospectus lists 22 selling stockholders who propose to sell all of their holdings, including Allen & Co., which proposes to sell 100,170 shares, F. William Harder, who proposes to sell 28,500 shares, and Delaware Coach Co., which proposes to sell 25,000 shares.

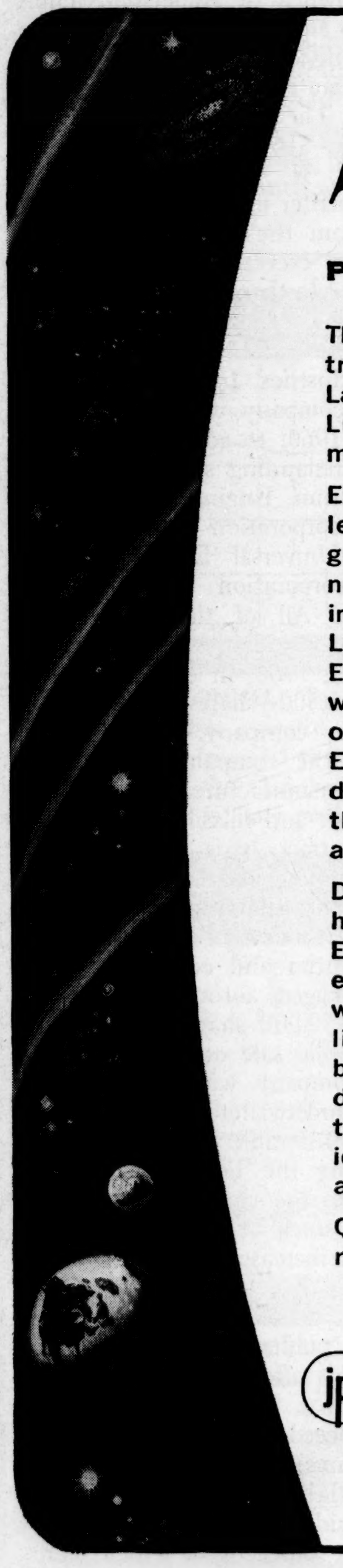
Avnet Electronics Corp., Westbury, N. Y., engaged in the business of assembling and distributing an extensive line of electrical connectors and in distributing transistors, diodes, capacitors and other items related to the electronics, communications, aircraft, missile, utility and business machine industries. It also assembles and makes available for sale its own electrical connector and cable testers. Offering is 505,561 shares of common stock. It is proposed to offer 144,446 shares of such stock to the former stockholders of British Industries Corp. in accordance with the terms of a consolidation of the two companies, at the rate of one share of Avnet for each 2½ shares of British Industries common stock held of record at the effective date of the consolidation. The rights are evidenced by transferable purchase warrants; each warrant evidences the total number of rights to which the former British Industries shareholder is entitled, two rights for each share held; five rights are required to subscribe for each share of stock; purchase price to be supplied by amendment. The remaining 361,115 shares represent shares of the company into which a like amount of outstanding shares of British Industries common stock are to be converted pursuant to the consolidation.

British Industries is engaged in the importation, manufacture and distribution of a diversified line of products principally in the electronics and high fidelity industry.

Financial Briefs

Douglas Aircraft Co. has sold its controlling interest in DataGraphic Systems, Inc., to General Analine and Film Corp. for an undisclosed amount. DataGraphic, a California corporation formerly owned jointly by Douglas and General Analine, develops machines and systems for microfilm miniaturization and data handling.

International Rectifier Corp., El Segundo, Calif., has been admitted for trading on the New York Stock Exchange. Its symbol is IRF. The company sales for the three months ended Sept. 30, 1960 were $3,337,496 compared with $3,216,197 for the same period in 1959. Earnings for this quarter were $280,667 as against $271,283 for the same period a year ago.



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Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Resultant Holdings for the period Aug. 11 to Sept. 12, 1960, reported the following transactions by two executives of Eastern Air Lines, Inc.; acquisition of 100 common shares by L. Orville Cameron, officer, making a holding of 806; disposition of 9,364 common shares by Laurance S. Rockefeller, director, his total holdings held indirectly through Company A (direct holding remains 91,800, and indirect holding held in trust remains 3,760).

Other transactions for the period Aug. 11 to Sept. 12 include the following:

Allegheny Airlines, Inc. Acquisition of 100 common shares by Nelson B. Fry, Jr., officer, making a holding of 100; acquisition of $75,000 of 6½% convertible debentures by Robert F. George, director, making a holding of $75,000.

American Airlines, Inc. Disposition of 500 common shares by Thomas M. Conroy, director, leaving a holding of 500.

American Research & Development. Acquisition of 200 common shares by Paul F. Clark, director, making a holding of 500; acquisition of 500 common shares by Merrill Griswold, director, making a holding of 3,100.

Ampex Corp. Acquisition of 1,125 common shares through exercise of option by Herbert L. Brown, officer, making a holding of 1,923; disposition of 1,000 common shares by Murray Innes, Jr., director, his total holding held in trusts (direct holding remains 3,000); disposition of 11,250 common shares by Henry A. McMicking, director, leaving a holding of 52,235.

Avco Corp. Acquisition of 2,500 common shares through exercise of option by A. R. Kantrowitz, officer and director, making a holding of 8,500; disposition of 3,300 common shares by Matthew A. McLaughlin, officer and director, leaving a holding of 6,000; disposition of 3,000 common shares by W. A. Mogensen, director, leaving a holding of 6,000; disposition of $5,000 of convertible subordinated debentures by Victor Emanuel, director, leaving a holding of $50,000.

Braniff Airways, Inc. Acquisition of 700 common shares by Allan Shivers, director, making a holding of 700.

Cessna Aircraft Co. Acquisition of 3,100 common shares by Thomas B. Salter, officer and director, making a holding of 13,850.

Collins Radio Co. Disposition of 2,500 common shares by Max W. Burrell, officer and director, leaving a holding of 254; disposition of 542 common shares, his total holding, by M. L. Doelz, officer.

Continental Airlines. Disposition of 1,400 common shares by Lawrence C. Ames, director, leaving a holding of 8,000 and acquisition of $8,000 of 5¾% convertible subordinated debentures, making a holding of $25,000.

Fairchild Engine and Airplane Corp. Disposition of 20,000 common shares by C. Leo DeOrsey, director, leaving a holding of 15,000.

General Dynamics Corp. Disposition of 1,300 common shares by F. de Hoffmann, officer, leaving a holding of 723; disposition of 100 common shares by Patrick J. Sullivan, officer, leaving a holding of 400.

Grumman Aircraft Engineering Corp. Disposition of 4,000 common shares by Albert P. Loening, director, leaving a holding of 16,000.

Lockheed Aircraft Corp. Disposition of 500 capital shares by Herschel J. Brown, officer, leaving a holding of 479.

Loral Electronics Corp. Disposition of 500 common shares by Sheldon Simon, officer, leaving a holding of 25.

Marquardt Corp. Disposition of 1,300 capital shares by Laurance S. Rockefeller, beneficial owner, leaving a holding of 183,274; acquisition of 1,400 capital shares by Don L. Walter, officer, making a holding of 3,781.

Martin Co. Disposition of 1,000 capital shares by Jess W. Sweetser, officer, leaving a holding of 107; disposition of 1,000 capital shares by G. S. Trimble, Jr., officer, leaving a holding of 2,811.

Pan American World Airways. Disposition of 300 capital shares by John S. Woodbridge, officer, leaving a holding of 700.

Piper Aircraft Corp. Disposition of 1,500 common shares by Norman J. Greene, director, leaving a holding of 2,000; disposition of 1,600 common shares by W. T. Piper, officer and director, leaving a holding of 112,121 (indirect holding as trustee remains 154,350).

Raytheon Co. Disposition of 2,000 common shares by David D. Coffin, officer and director, leaving a holding of 1,812.

Resistoflex Corp. Acquisition of 1,445 common shares by Herman E. Krebs, officer and director, making a holding of 2,084.

Seaboard & Western Airlines, Inc. Disposition of 8,145 common shares, his total holding, by Carl D. Brell, officer; disposition of 3,050 common shares by Warren H. Renninger, officer, leaving a holding of 1,258; disposition of 4,400 common shares by John H. Rosenwald, officer, leaving a holding of 32,979; disposition of 11,000 common shares by F. H. Vahlsing, director, leaving a holding of 27,600.

Servomechanisms, Inc. Disposition of 6,000 common shares by Ernest A. Wester, director, leaving a holding of 19,000.

Stanley Aviation Corp. Disposition of 1,243 common shares by Richard H. Frost, officer and director, leaving a holding of 2,307.

United Aircraft Corp. Disposition of 1,000 common shares by H. Mansfield Horner, director, leaving a holding of 8,000 (indirect holding in trust remains 1,080); disposition of 1,000 common shares by W. A. Parkins, officer, leaving a holding of 1,032.

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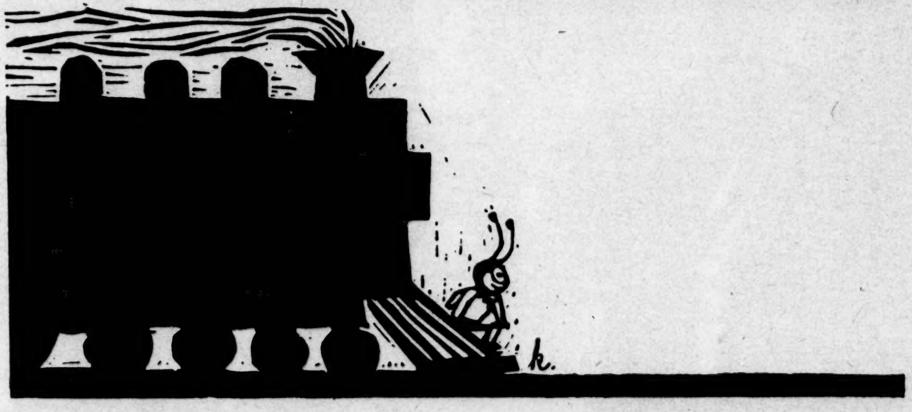
PROBLEMATICAL RECREATIONS 47



Stations A and B are 120 miles apart on a single-track railroad. At the same time that a train leaves A for B at 25 mph, a train leaves B for A at 15 mph. Just as the first train leaves A, a South American botfly flies from the front of the engine straight toward the other train at 100 mph. On meeting the second train it immediately turns back and flies straight for the first train. It continues to fly back and forth with undiminished speed until it is crushed in the eventual collision. How far had the fly flown? *—Of ancient Hindu origin*

Modesty has forbade us from mentioning until now that the Polaris-equipped submarine USS George Washington is also Litton-equipped with a Litton Electromagnetic Log, a Litton Mark 19 Navigational Plotter, and a Litton Water Velocity Flow Indicator.

ANSWER TO LAST WEEK'S PROBLEM: He could put his gun diagonally in a cubical box, 1 yard on a side.

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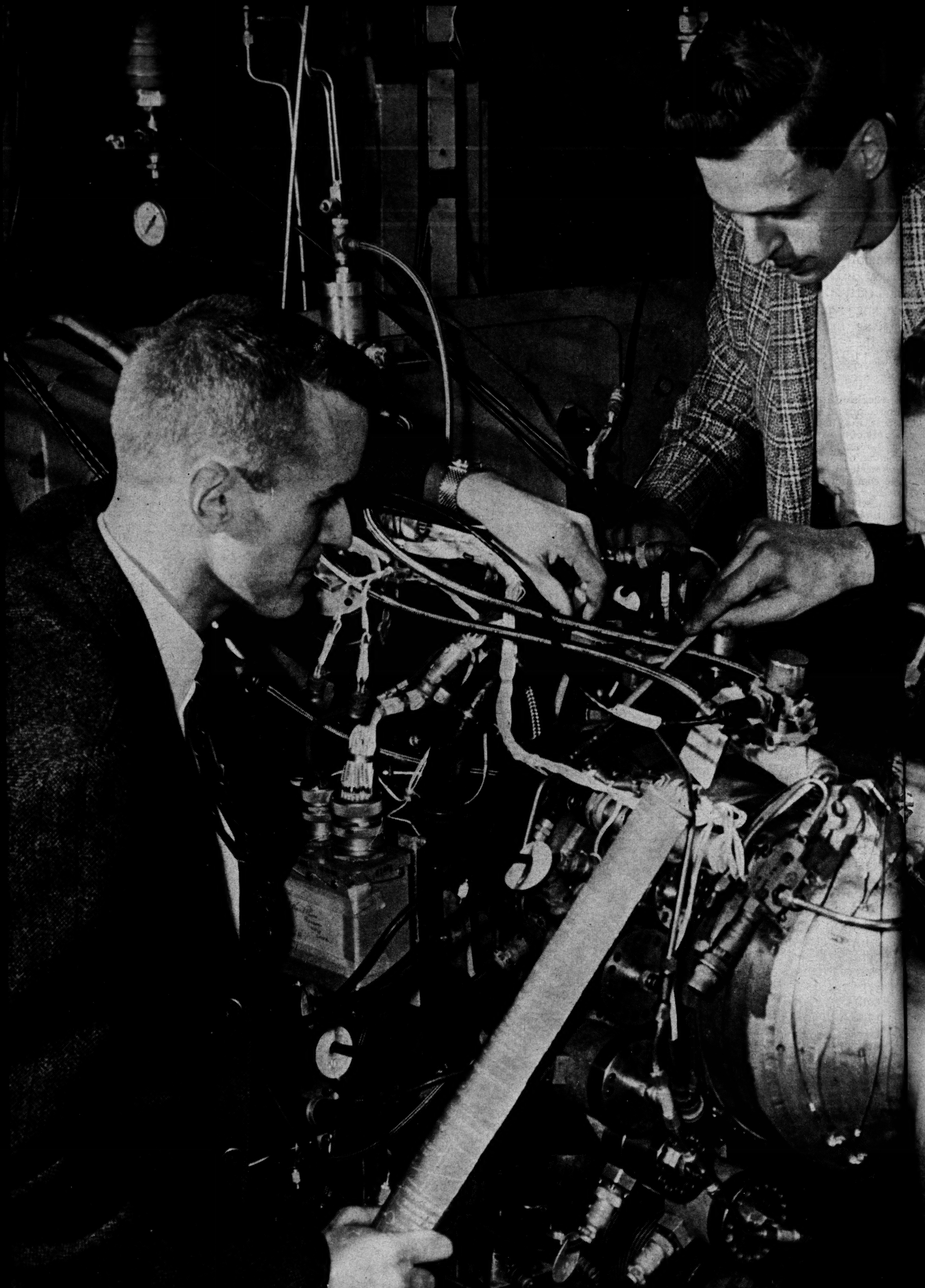

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WHO'S WHERE

(*Continued from page 13*)

Changes

Herman Miller, head of the newly established Special Purpose Nuclear Systems Operation, Atomic Products Division, General Electric Co., Palo Alto, Calif.

Dr. Joseph B. Philipson has joined the staff of the Solid Rocket Development Division of Aerojet-General Corp., Sacramento, Calif.

John S. Harrison, base activation administration manager, Convair (Astronautics) Division of General Dynamics Corp., San Diego, Calif., and **Edward J. Huntsman,** base activation works manager.

E. H. Nett, sales administrator, Teco, Inc., Burbank, Calif.

Dr. Edward H. Seymour, general manager, Reaction Motors Division of Thiokol Chemical Corp., Denville, N. J., succeeding **Raymond W. Young,** now director of advance planning.

Peter D. Audo, director-standards and quality control, Vapor Heating Corp., Chicago, Ill.

Omer D. Whitwell, manager-advanced planning and market research, Link Division of General Precision, Inc., Binghamton, N. Y.

The Defense Products Group of Daystrom, Inc., Murray Hill, N. J., has appointed **Norman O. Ranz** as director-marketing operations and **James E. Young,** Dayton (Ohio) regional representative. Daystrom's Military Electronics Division, Archbald, Pa., has appointed **Edgar G. Grant** as director-new product planning and **Pat Minervini,** engineering manager.

Robert L. Mettey, service manager, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

Mark Rosen, development engineer, Datex Corp., Monrovia, Calif., a subsidiary of Giannini Controls Corp.

J. N. Marshall, manager-advanced systems development engineering, Electronic Data Processing Division, Radio Corporation of America, New York, N. Y.

Weldon R. Orme, manager-flight test operation, General Electric Co.'s Defense Systems Department, Syracuse, N. Y., succeeding the late **Curtis G. Talbot.**

Ryan Transdata, Inc., San Diego, Calif., a subsidiary of Ryan Aeronautical Co., has announced the following appointments: **Franklyn E. Dailey, Jr.,** manager-engineering and research; **Josh W. Gershuny,** manager-marketing; **Gordon L. Johnson,** manager-planning.

Woodrow Smith, engineering manager, Babcock Electronics Corp., Costa Mesa, Calif.

Russell Ellsworth, director-customer relations, FMA, Inc., El Segundo, Calif.

Dan L. McGurk, director of marketing, TRW Computers Co., Beverly Hills, Calif., a division of Thompson Ramo Wooldridge.

Eugene L. Woodcock has been appointed to the Senior Technical Staff, Electro-Optical Division, Perkin-Elmer Corp., Los Angeles, Calif.

Fred A. Speaks, director, Marketing Division of Eitel-McCullough, Inc., San Carlos, Calif.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JANUARY 2, 1961

AIRWORK CORPORATION 69
AMERICAN MACHINE & FOUNDRY CO., GOVERNMENT PRODUCTS GROUP 8
ANELEX CORPORATION 5
AUTONETICS, A DIVISION OF NORTH AMERICAN AVIATION, INC 12
AVIATION WEEK AND SPACE TECHNOLOGY..86-87

BELL AEROSYSTEMS COMPANY 35
BENDIX SYSTEMS DIVISION, THE BENDIX CORPORATION 14

CESSNA AIRCRAFT COMPANY 6
COLLINS RADIO COMPANY AVIATION DIVISION 36

DELCO RADIO DIVISION, GENERAL MOTORS CORPORATION 44
DONNER SCIENTIFIC COMPANY 72

EMERY INDUSTRIES, INC., ORGANIC CHEMICALS DIV. 60

GARRETT CORPORATION, THE 93
GOODYEAR AIRCRAFT CORPORATION, THE.... 3
GOVERNMENT PRODUCTS GROUP, AMERICAN MACHINE & FOUNDRY CO 8

HOUSTON FEARLESS CORPORATION, WESTWOOD DIVISION 7

JET PROPULSION LABORATORY 84

KAYNAR MANUFACTURING COMPANY, INC. ....2nd Cover
KINETICS CORPORATION 61

LABORATORY FOR ELECTRONICS, INC....3rd Cover
LITTON INDUSTRIES, INC 85
LOS ANGELES DIVISION OF NORTH AMERCAN AVIATION, INC 81

M-D BLOWERS, INC 65

R. C. A. SERVICE COMPANY 88
ROCKETDYNE, A DIVISION OF NORTH AMERICAN AVIATION, INC 48-49, 85, 93
RYAN AERONAUTICAL COMPANY, AERO LAB.. 75

SOLAR AIRCRAFT COMPANY, A SUBSIDIARY OF INTERNATIONAL HARVESTER COMPANY. 62
SPACE TECHNOLOGY LABORATORIES, INC. SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC. 10

TEXAS INSTRUMENTS INCORPORATED 52
THOMPSON FIBER GLASS COMPANY, H. I 66
TIMKEN ROLLER BEARING COMPANY, STEEL & TUBE DIVISION 4

VARIAN ASSOCIATES, TUBE DIVISION....4th Cover
VERTOL DIVISION OF BOEING AIRPLANE COMPANY 56-57
VICKERS ARMSTRONG, LTD 38-39

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

WHERE TO BUY
Mercury Air Parts Co. Inc 92
EMPLOYMENT OPPORTUNITIES 91
EQUIPMENT
(Used or Surplus New)
For Sale 92

ADVERTISERS' INDEX

Ayer & Associates Inc. Frederick B 92
The Bristol Company 90
Bell Helicopter 89
California Airmotive Corp 92
Collens Instrument Company Inc 92
Cornell Aeronautical Laboratory Inc 90
GPL Division General Precision Inc 92
King Radio Corporation 89
Lear Inc. 91
Linden Flight Service Inc 92
The Port of New York Authority 89
Steiner & Co. William 92
Superior Oil Co. 92
Thompson Ramo Wooldridge Inc 91

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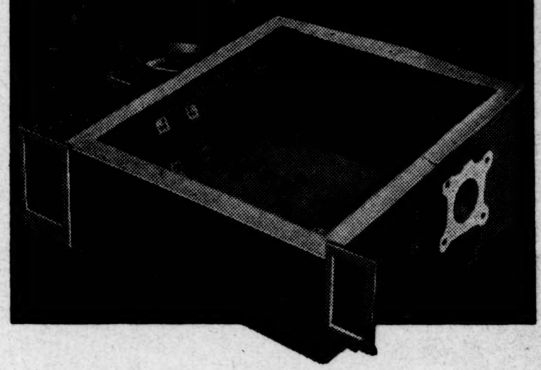

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LETTERS

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Jet Fuel Safety

I read with interest the report in your Oct. 3 issue (p. 92), giving details of Mr. Beard's statements before the American Chemical Society concerning the reduced number of fire accidents with kerosene fuel. I would like to comment on some of these statements, but first of all I and others in this country offer our sincere congratulations to American Airlines (and, indeed, to most other U. S. airlines) for choosing kerosene for their turbine-powered aircraft. This is a major step forward in increasing the safety of air travel.

My comments fall broadly into four sections as follows:

(1) I am surprised that for the 18 months under review Mr. Beard was able to find as many as 33 accidents to kerosene-fueled aircraft. As he does not say otherwise, I can only assume that that figure must embrace a large number of very minor accidents in which no one would be expected to be hurt, and also some major catastrophes such as the midair breakup of the Braniff and Northwest Electras. In accidents of the latter type, the fuel is wholly irrelevant. Also, Mr. Beard's figures, by drawing attention to the fatal kerosene accidents with fire, completely mask a most important manifestation of kerosene safety which is this: that people do seem to be escaping from very severe crashes of kerosene-fueled aircraft even though, perhaps in any given case, the majority of the occupants have been killed by impact. One of the best examples of this occurred near Benghazi in 1958 where a Viscount flew into the ground (due possibly to a misreading of the altimeter), and although 36 occupants were killed no less than 18 escaped as a result, it must be presumed, of the relatively slow fire development. Several similar accidents have occurred to kerosene-fueled aircraft. The great advantage of kerosene, then, is not so much that it is less likely to catch fire but rather that, once ignited (as it easily can be by hot surface ignition), the rate of fire development is so much slower than in the case of gasoline or JP-4.

(2) Mr. Beard is correct in stating that few figures are available for comparing the safety of the two jet fuels in commercial operation; this is presumably because, until recently, the only commercial user of JP-4 was TCA and as their general safety record is of a very high order it is doubtful whether such fire incidents as they have had can make any statistical impression.

It follows from first principles, however, that JP-4 cannot be significantly safer than gasoline because in almost all accidents it will be at a temperature above its flashpoint. From the standpoint of fuel tank explosion in flight and on the ground (both during refueling and following a cash), kerosene is much the safer for most environments whereas JP-4 is more dangerous than gasoline.

(3) Mr. Beard states that the generation of static electricity has been considered a major hazard in handling kerosene. This has certainly caused some concern and further research has recently been undertaken not only in the U.S.A. but in this country as well (the Shell Co.). As I understand it, the findings here are that there is no difference between kerosene and JP-4 from this particular standpoint. If these findings are generally accepted, we should be able to dispose of this alleged hazard once and for all. The possibility of substantial static build-up still remains with very high rates of refueling and this must obviously be carefully watched, but the greater danger must lie with JP-4 which will readily produce explosive fuel/air ratios whereas kerosene will not. This follows from basic inflammability data.

(4) Now I come to the most controversial point of all. Why do some operators use JP-4? Mr. Beard states that this was necessary during early jet operations when kerosene was not widely available within the U. S. This I understand and readily accept, but I do not believe it applies to the overseas operations of PanAm and TWA, both of whom are known to be using JP-4. These airlines claim that kerosene is not readily available at some airports along their routes; I should very much like to see a list of these airports. It should be borne in mind that Comets, Viscounts and Britannias have been operating over large areas of Europe, Africa and Asia for several years. In any case, since when has kerosene been in short supply at London Airport? It has recently been reported in the British press that, because some operators are now refueling with JP-4 at London (PanAm being cited as one of these), the Ministry of Aviation has ordered a wider dispersal of aircraft because of the greatly increased fire risk.

The airlines are naturally reluctant to admit why they are changing to JP-4 but, unfortunately for them, IATA has already let out the truth of the matter. At their 13th Technical Conference held in Lucerne earlier this year, Mr. Knut Hagrup (of SAS), who led the committee on jet fuels, admitted that as JP-4 tended to become cheaper than kerosene more operators would be going over to it. Let me quote Mr. Hagrup: ". . . kerosene is IATA's recommended standard specification but the financial people want us to tank up the aircraft with kerosene in one place and JP-4 in another." While this vital safety matter is dictated by the finance people, I cannot but wonder what the engineering people are doing.

As an illustration of how "two faced" an airline can be over this matter, allow me to refer again to Mr. Hagrup who, at the IATA Annual General Meeting in Copenhagen in September, vigorously asserted that no one could tell whether one fuel could be safer than another. Now, in September, 1957 (when it appeared that there was unlikely to be any price difference between kerosene and JP-4), there was convened in Stockholm a meeting attended by the major European airlines and representatives of the major oil companies. This meeting, which discussed turbine fuels, was chaired by Mr. Hagrup's predecessor at SAS, a Mr. Hagerup-Svendsen, the then deputy and vice president, engineering and research. Having heard the evidence of the oil companies concerning the relative safety of kerosene and JP-4, Mr. Hagerup-Svendsen, speaking on behalf of the airlines, said this: ". . . it did not take us a long time to decide that kerosene was the safer one [fuel]. . . ."

Can Mr. Hagrup now explain away this change of face?

It is my contention that if kerosene does become more expensive the airlines must be prepared to pay the extra cost. We are being told that the supersonic era is inevitable, regardless of economic consequences. If the money can be found for this, I insist that a comparatively small investment can be made toward providing the safest fuel available for present day aircraft. I have personally indicated to the offending airlines that I am unprepared to use their services on principle, and I urge others to do the same. Kerosene should be regarded as part of the safety equipment, and no passenger should consent to being flown in a turbine-engine aircraft with any other type of fuel, just as he would not now consent to crossing the ocean without a lifejacket under his seat.

With regard to the attitude of the airworthiness authorities, it is worthy of note that the chairman of the Air Registration Board has this year twice denounced, in public, what he refers to as the "disgraceful practice" of the use of JP-4 fuel.

I would be the first to admit that most of the airlines now using JP-4 have excellent safety records, but this is in part due to a measure of good fortune. The worst aspect of the matter is the bad example being set before the uncommitted airlines of the world, some of whose safety records are, let's face it, not of the best. Air safety must be regarded in a worldwide context, and not just parochially.

Finally, unless and until the contrary is proved, it must be assumed that the crash of the kerosene-fueled Electra at LaGuardia in September has provided the finest example to date of the greater safety of kerosene. Those 76 people who walked out of the inverted, burning wreck can be thankful that their aircraft belonged to American Airlines and not to one of the protagonists of JP-4.

Once again, congratulations American.

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Harpenden
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Bell Engine Story

Thought Mr. Yaffee's story (AW Nov. 21, p. 52) on Bell's Hustler engine was particularly well done.

We will be looking forward to more such reports.

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